POWER

Volume 64 New York, August 3, 1926 *Number* 5

The Obstructionist

THINGS are supposed to move along the path of least resistance, but every great forward move in the history of the race has been made against resistance and obstruction.

The majority is always wrong, and the man who points the new way will be made the subject of the jibes of those to whom anything but the usual seems grotesque, the curses of those whose interests are affected and the dead weight of masses bound by usage and inertia.

James Watt called Trevethick a murderer because he wanted to carry fifty pounds pressure. Watt did a great service to mankind and demonstrated his powers of thought and action, but he could not foresee a time when three and four hundred pounds would be common usage.

Doctor Lardner demonstrated that a steamer could not carry coal enough to propel itself across the Atlantic. Somebody dared to try it in spite of his opposition, and we have the floating hotels of today.

When Murdock proposed piping inflammable gas into dwellings, he was roundly condemned. When the electric light appeared, the holders of the securities of the gas companies were in an awful fret.

The gas properties are still good and the public has infinitely better lighting service than gas could ever supply.

Many amusing tales are told of opposition to the building of railways. Printing was established against the opposition of the scribes, and labor-saving machinery of all kinds has been smashed and abused by those who thought that it was putting them out of a job.

Instances of such obstruction are still all too common and the field of power is not free from them.

Don't be an obstructionist.

F. R. Low

Balfour Mill Insures Operation *By* Installing Power Plant

THE installation of a power plant by the Balfour Mill located at Smyth, in the western part of North Carolina, is an example of the present-day tendency among Southern textile factories. Last year industries in the Southeastern States depending upon hydro-electric power were seriously handicapped by the lack of water. The majority of the textile plants, especially the spinning mills, have little use for process steam and the equitable climate makes the steam-heating demand of minor importance. As a consequence, the majority of the mills erected during the last twenty years in North Carolina, South Carolina and Georgia installed one or two boilers for heating and purchased electrical energy from the available public utility, which power was in the main obtained from hydro-electric developments.

PRINCIPAL PLANT RATIOS

Ground area of plant	53 ft. 1 in. x 72 ft. 1 in.		
Dimensions:	Length	Width	Height
Boiler room	50 ft. 5 in.	42 ft. 9 in.	33 ft.
Turbine room	49 ft. 9 in.	24 ft. 4 in.	28 ft.
Capacity of turbine, kw.	1,000		
Boiler-heating surface, sq.ft. total	4,660		

RATIOS

Building volume cu.ft. per kw. plant capacity	105
Total floor space per kw. capacity, sq.ft.	3.43365
Plant capacity, kw., vs. No. of boilers	500
Boiler-heating surface, sq.ft., vs. plant capacity, kw.	4.6
Boiler-heating surface, sq.ft., vs. sq.ft. boiler-room floor space	2.16
Boiler-heating surface, sq.ft., vs. sq.ft. of grate surface	44.2
Boiler-heating surface, sq.ft., vs. superheater surface, sq.ft.	15.9
Boiler-heating surface, sq.ft. vs. furnace vol. cu.ft.	6.68
Furnace volume, cu.ft. vs. grate area, sq.ft.	6.8
Draft-fan capacity, cu.ft. per min. vs. furnace vol., cu.ft.	1.8
Draft-fan capacity, cu.ft. per min. vs. plant capacity, kw.	12.5
Stack area, sq.ft., vs. furnace vol. cu.ft.	0.055
Stack area, sq.ft., vs. fans capacity, cu.ft. per min.	0.003
Circulating pump g.p.m., vs. plant capacity, kw.	0.2
Circulating pump horsepower, vs. plant capacity, kw.	0.4
Condensate pump hp., vs. plant capacity, kw.	0.003
Gen. air cooling water, g.p.m., vs. plant capacity, kw.	0.2
Gen. air cooling, hp., vs. plant capacity, kw.	0.0015

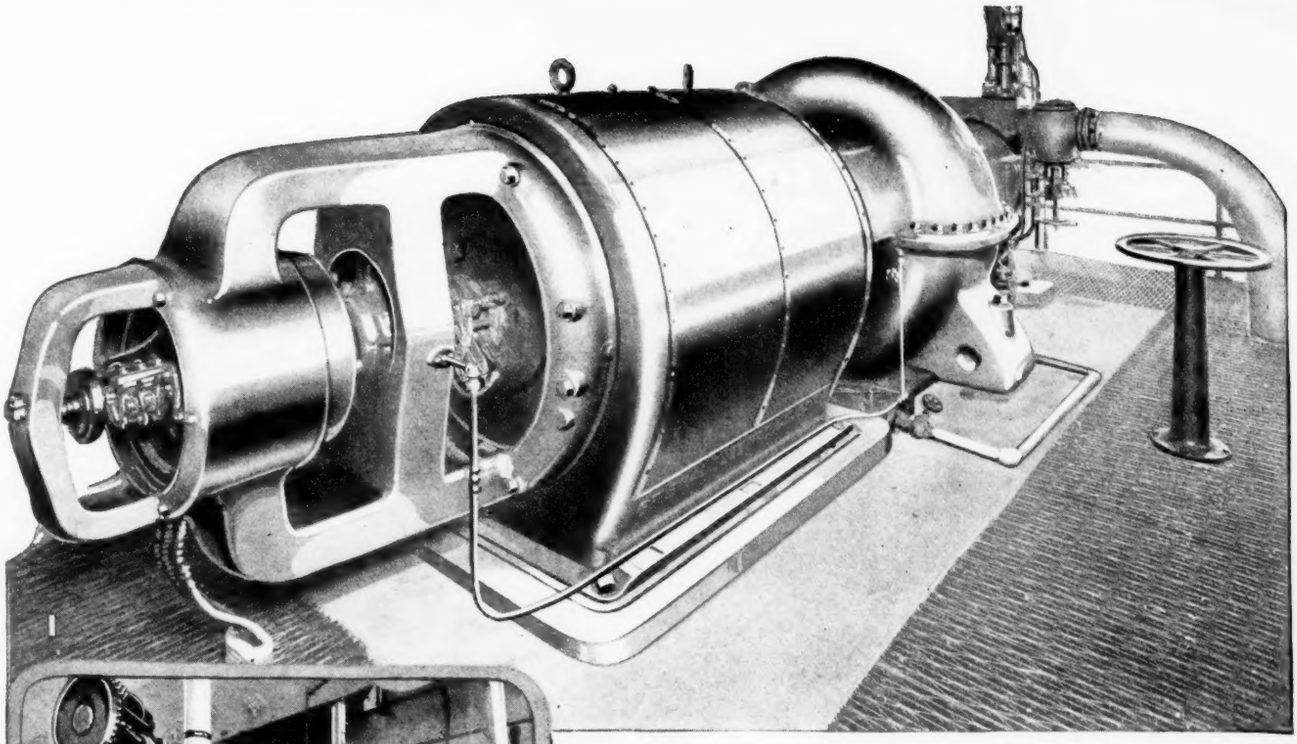
Fluctuations in water flow seem to follow a well-defined cycle, and in recent years the connected loads have far exceeded the hydro-electric outputs during the low points on the water-flow curve. The public utilities had installed stand-by steam plants ample to care for the normal water deficiency, but insufficient to supply the electric power demand when low water conditions such as existed last year, confronted them.

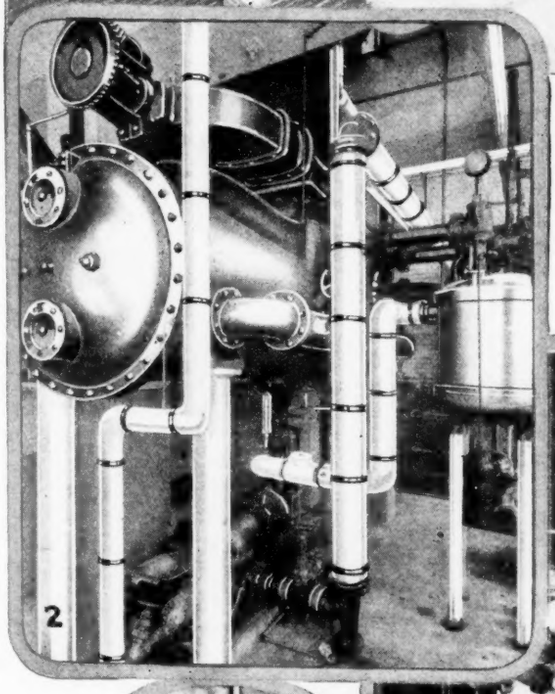
As is generally known, the Southern industries were compelled to shut down from one to three days a week during the entire summer of 1925. Some of the mills were permitted to operate continuously for periods of 24 to 48 hours, followed by a similar period of shut down. That disordered market conditions followed was of course to be expected, and to insure a continuity of power many of the cotton mills have installed their own generating units, among these being the Balfour Mills.

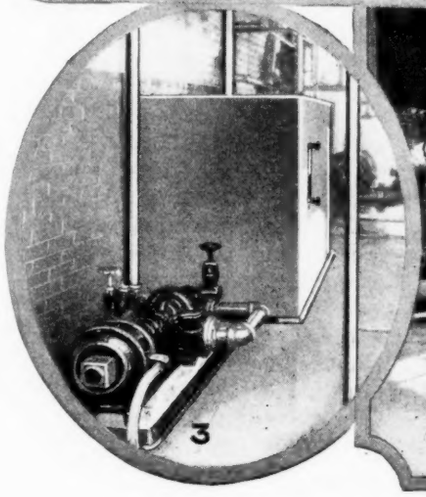
PRINCIPAL EQUIPMENT, BALFOUR MILL

Boilers, type	Cross-drum, water tube
Make	Babcock & Wilcox Co.
Sq.ft., each	2,330
Stokers, type	Single-retort, side-dump
Draft fan, make	Combustion Engineering Corp.
Capacity, cu.ft. per min.	12,500
Superheater, make	Babcock & Wilcox Co.
Soot blowers	Diamond Power Specialties Corp.
Non-return valves	Edwards Valve Co.
Water columns	Reliance Gage Column Co.
Blowoff valves	Yarnall-Waring Co.
Feed-water regulator	S. C. Regulator Co.
Feed-water heater, type	Open, metering
Make	Warren Webster & Co.
Draft gage, make	Republic Meter Co.
Boiler-feed pump (2), type	Steam duplex
Size	8x5x12
Make	Dean Bros.
Turbine, size, kw.	1,000
Make	Gen. Elec. Co.
Condenser, type	Surface, 39 in. dia. 12 ft. 2 in. two-pass
Make	C. H. Wheeler Mfg. Co.
Hotwell pump	2½-in. centrifugal d.c. to G. E. turbine
Condensing-water pump	8-in. centrifugal d.c. to 40-hp. motor
Generator air washer	American Blower Co.
Capacity of pump, g.p.m.	25
Pump drive	1½-hp. motor
Valves	The Wm. Powell Co.

These mills had a boiler plant containing a return-tubular boiler that was used for steam heating. This was abandoned and an entirely new building of concrete







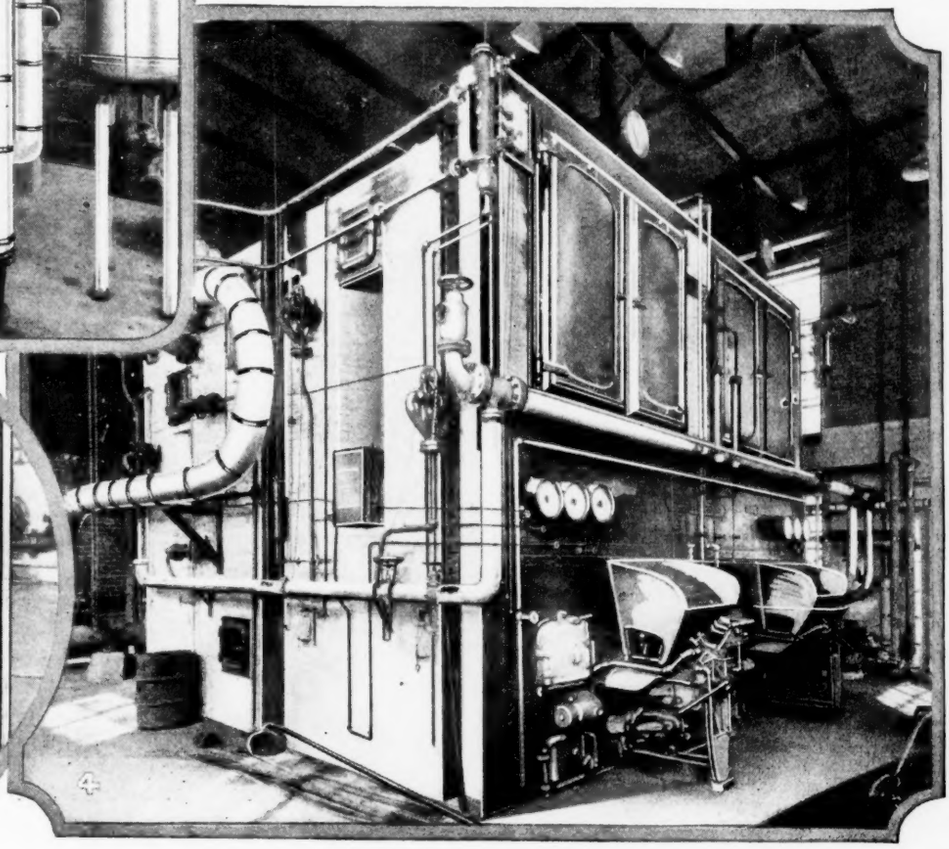


Fig. 1—View of the 1,000-kw. turbine

Fig. 2—Condenser and steam-jet air pump

Fig. 3—Drip tank and pump

Fig. 4—The cross-drum boilers are stoker fired

and brick erected about 300 ft. from the mill buildings. Inasmuch as no process steam was needed, it was deemed logical to install a condensing generating unit and use live steam for the little heating that was needed.

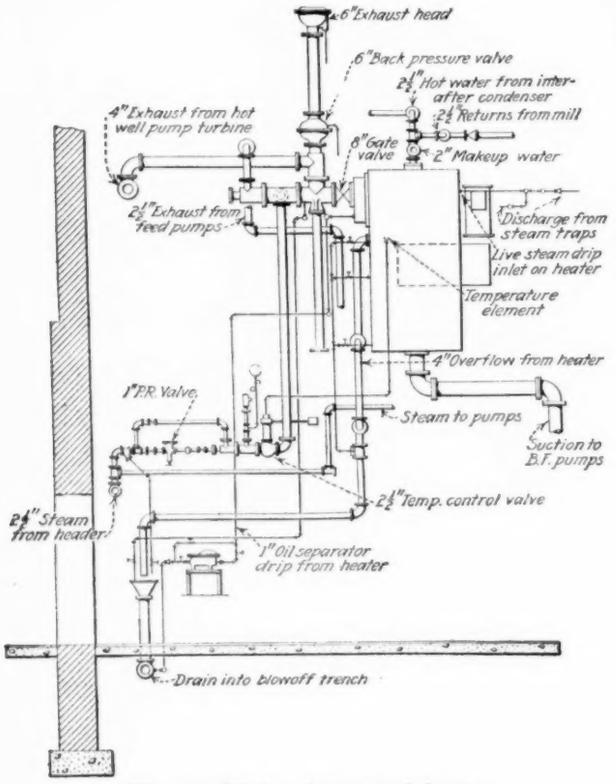


Fig. 5—Piping layout of heater

The 1,000-kw. turbo-generator unit is placed on a concrete entablature approximately 15 ft. from the ground floor and supported by concrete columns. Between these columns is the surface condenser with its twin steam-jet air pumps and after condenser. The 8-in. single-stage centrifugal pump handling the cooling water is direct connected to a 40-hp. motor, and is placed between the condenser and the boiler-room wall.

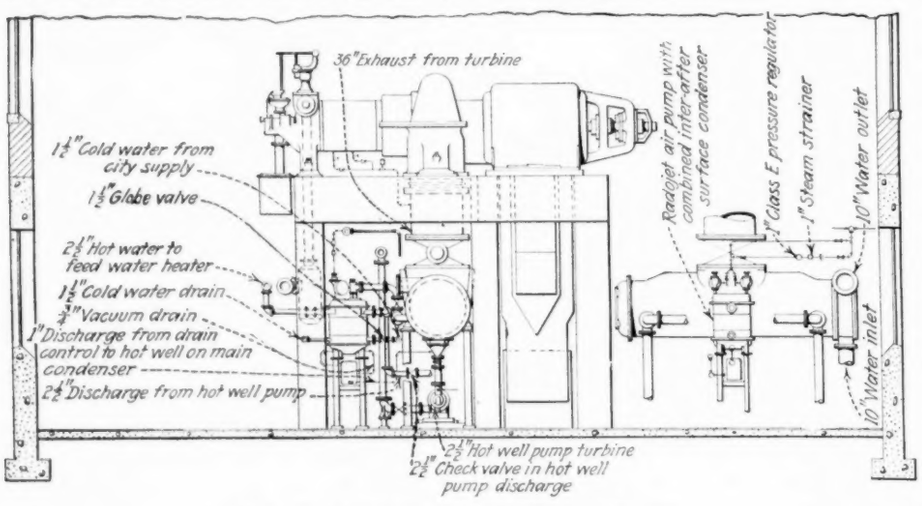

36"Exhaust from turbine
1½"Cold water from city supply
1½"Globe valve
2½"Hot water to feed water heater
1½"Cold water drain
¾"Vacuum drain
1"Discharge from drain control to hot well on main condenser
2½"Discharge from hot well pump
Radojet air pump with combined inter-after surface condenser
1"Class E pressure regulator
1"Steam strainer
10"Water outlet
10"Water inlet
2½"Hot well pump turbine
2½"Check valve in hot well pump discharge

Fig. 6—Connections at the condenser

Cooling water is obtained from a cooling pond, shown in the headpiece, and is forced through the condenser and then out of the twenty 1½-in. spray heads placed above the pond.

The air for the generator cooling is taken from the turbine room and drawn through an air washer, where water sprays remove the dust. The water from the sprays settles in the bottom of the steel spray tank and is drawn out by a centrifugal pump and again forced through the spray pipe. After leaving the generator the air is drawn into the forced-draft fan in the boiler room and discharged into the furnace air duct. In this way the internal losses of the generator are returned to the furnace and are not lost.

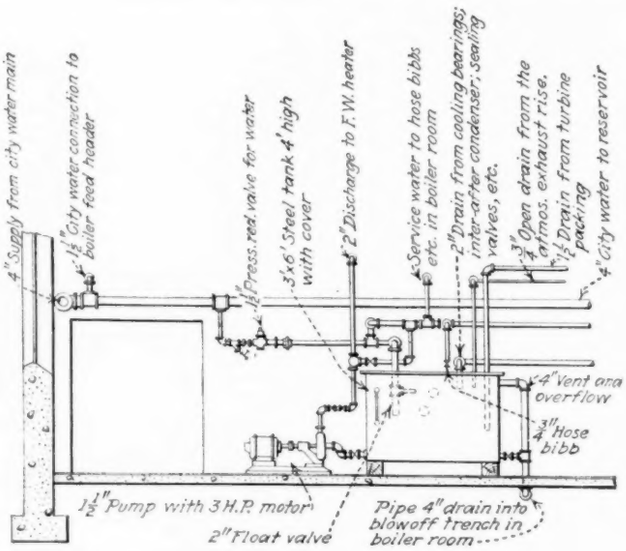

4"Supply from city water main
1½"City water connection to boiler feed header
1½"Press.-reg. valve for water
3'x6' Steel tank 4' high with cover
2"Discharge to F.W. heater
Service water to hose bibb etc. in boiler room
2"Drain from cooling bearings; inter-after condenser; sealing valves, etc.
3"Open drain from the atmos. exhaust rise.
½"Drain from turbine packing
4"City water to reservoir
4"Vent and overflow
¾"Hose bibb
1½"Pump with 3 H.P. motor
2"Float valve
Pipe 4"drain into blowoff trench in boiler room

Fig. 7—Design of drip tank and connections

One unusual feature is the system of feed-water makeup. All the drips and traps discharge into an insulated cubical plate steel receiver shown in Figs. 3 and 7. The raw-water makeup also enters this tank, the level of which is controlled by a float valve. A 1½-in. centrifugal pump delivers the water from the tank into the heater, while the condensate from the condenser and the mill returns enter the heater directly. Inasmuch as the load on the plant will be fairly uniform, the condensate flow will at all times approximate the boiler - feed requirements when the drip returns are added. For this reason the makeup is not put into the heater but into the drip tank and the large heater capacity permits some variation in the feed demand without the addition of any makeup. The heater is supplied with steam from the hotwell pump turbine and from the feed pump. A temperature control has been added which opens a live steam line in case the water temperature drops below the desired point.

Steam is supplied by two 2,330-sq.ft. horizontal cross-drum water-tube boilers built for 250 lb. and equipped

with superheaters to raise the steam temperature 100 deg. F. The steam header is behind the boilers and rests on roller floor stands. All lines to the various auxiliaries as well as that to the turbine are taken from the header, and up to date no trouble has been experienced with the boiler-feed pumps due to the use of superheated steam.

These two boiler-feed pumps are 8x5x12 outside end packed duplex steam-driven units, placed at one side of the boiler battery and against the side wall.

Single-Retort Side-Dump Underfeed Stokers

The boilers are fitted with single-retort side dump stokers of the underfeed type with steam-operated rams. The furnaces are equipped with a balanced draft sys-

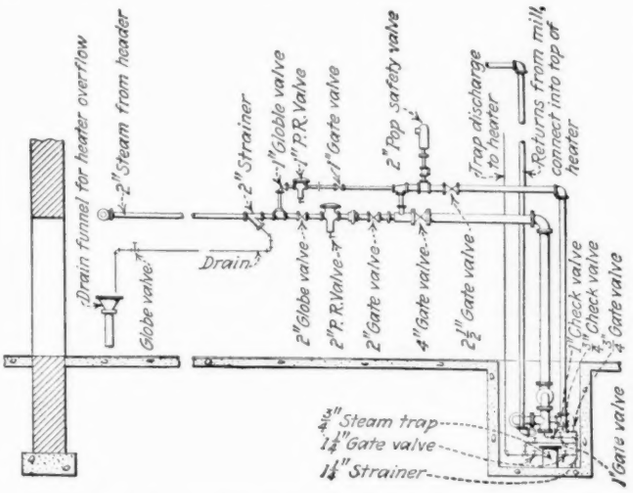


Fig. 8—Steam line to buildings with its several connections

tem. The air for combustion is handled by a double suction fan direct connected to a variable-speed alternating-current motor. One suction connection leads, as has been mentioned, to the generator casing, thereby making use of the generator cooling air. The second suction opening is connected to a steel duct taking air from immediately above the boiler smoke breeching.

The plant is supplied with coal scales, steam-flow meter, recording watt-hour meter, V-notch feed-water meter as well as the usual indicating instruments found in modern industrial plants.

The plant started in operation the latter part of February. It is intended to run 120 hours per week, that is, from Monday morning to Saturday morning. At present, when carrying considerably less than full load, generating 60,000 kw.-hr. per week, the coal per kilowatt-hour averages 2.46 lb. This compares favorably with the majority of central stations and illustrates how modern equipment can help reduce power costs in industrial plants. J. E. Serrine & Co., Greenville, S. C., were the consulting engineers.

The Kinetic Energy of a body is a measure of the work that has been done on that body. For any change of velocity the work done on the body (ft.-lb.) equals the mass of the body (lb. weight divided by 32.2), multiplied by one-half the difference between the square of the final velocity and the square of the initial velocity. This is true even though the force and acceleration are not constant.

Keeping Racks Clean at Hydro-Electric Plants

By M. B. Thurston

Because the top of the racks at the intake to a hydraulic power plant are clean, this is no indication that everything is all right all the way down. In some cases, particularly on streams where there is a lot of refuse carried down from industrial plants, the intake may fill up from the bottom. Although a careful raking of the racks will show them to be clean down as far as the rake will go, only the upper section of the racks is being reached. As the intake fills up from the bottom, the available rack area is reduced and the water velocity through the racks increased. Cases come to mind where the loss of head due to this cause has amounted to one foot or more. With a plant operating normally under a 20-ft. head, one foot loss through the racks is a 5 per cent loss of the power, for the water available.

Another cause of loss of head through racks is improper raking. The operator, instead of reaching all the way to the bottom with the rake, goes down only far enough to give a good appearance on the surface. All the time the racks are gradually filling up at the bottom and causing an increase in water velocity through the top section, with an increased loss in head. A case in mind is that in a plant where the purchaser was very particular about the last fraction of a per cent in guaranteed efficiency of the turbine. After the unit had been in operation some time, a complaint was made that the power of the unit had fallen off considerably since it was installed.

An inspection of the plant revealed that the water level dropped about two feet in going through the racks, although everything appeared all right at the surface. When the plant was installed, a rake with a ten-foot handle was provided, but now the handle had been reduced to about five feet in length. After a new handle of sufficient length had been put into the rake, it was found that the lower five feet of the racks were practically closed with trash. Clearing this out brought the turbine back to normal operation. On making inquiries it developed that the operator had found the long rake handle awkward to use, so solved the problem by cutting off five feet.

Tests Made on a Single-Phase induction-type watt-hour meter, by Abner R. Knight and Max A. Faucett at the University of Illinois, showed that when the permanent magnets were heated to a temperature of about 50 deg. C., above room temperature, it resulted in an increase of 4 to 5 per cent in the registration of the meter. After the magnets cooled, the meter returned to its original registration, showing that the magnets did not undergo any permanent change in strength. Effects of heating of the meter's disk were also determined. When the disk was acted upon by the driving element only, heating of the disk caused a decrease in the registration of the meter, but when the disk was acted upon by the damping element only, its heating caused an increase in the registration. When the disk was acted upon by both the driving and damping elements, heating caused an increase in registration, showing that the effect of increased temperature is greater on the damping side than on the driving side.

Does the Motor Fit the Pump?

Easily Made Tests and Keeping Simple Records Will Answer This Question for You

By J. ELMER HOUSLEY

A DETAILED description of the methods used in testing a vacuum pump in order to adjust the load on the motor and determine the capacity of the pump.

AFTER the installation of a new motor drive is completed in a plant, a careful test on the motor is dictated by many reasons. Some of these are shown in the particular test to be described, the test serving merely to illustrate the method.

A pneumatic system for unloading soda ash in bulk from box cars was equipped with a 40-hp. 440-volt 860-r.p.m. 25-cycle squirrel-cage motor operated on a 30-cycle 440-volt system driving a vacuum pump through a belt. The exact pulley sizes required could not immediately be determined, and the pump was temporarily equipped with a pulley giving too high a speed. A recording wattmeter, indicating ammeter and a voltmeter were connected in the circuit before the drive

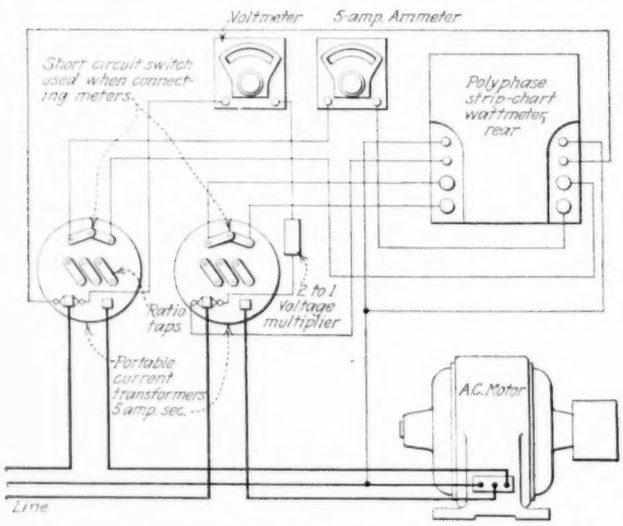


Fig. 1—Diagram of meter connections for making motor test

was started, as indicated in Fig. 1. The speed of the motor and pump and the temperature of the stator were taken every 15 min., in addition to the readings of the meters. A glass "U" tube was made up and filled with mercury and connected to the pump suction. The tube was mounted on a board and a scale attached to give a reading of the vacuum.

The frequency was read at 15-min. intervals by the power-house switchboard operator. The rated speed of the pump was 310 r.p.m., but the test speed ranged from 427 to 432 r.p.m. and, as expected, the load was excessive for the motor. The maximum input was found to

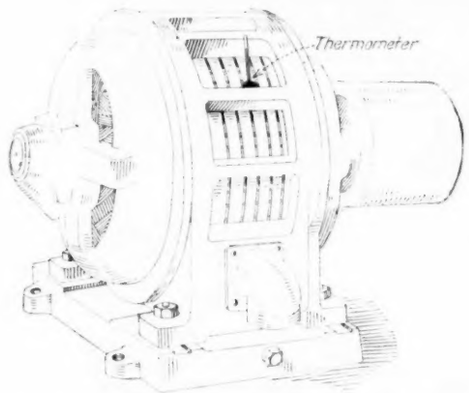


Fig. 2—Temperature of motor was taken with a thermometer held on the stator core with a piece of putty

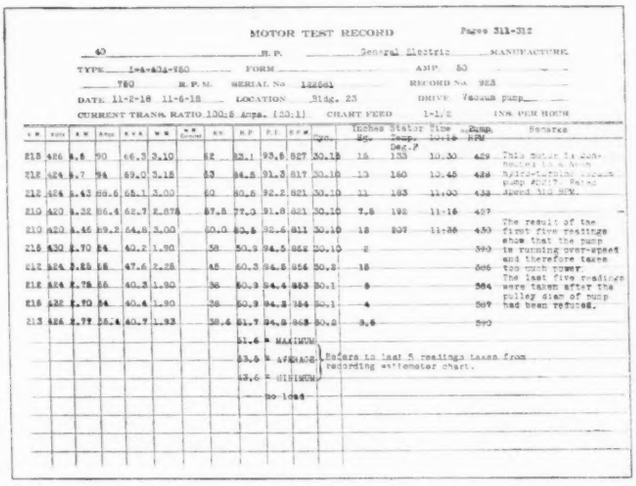
be 63 kw., while the full load should be about 37 kw. This can be obtained by the formula, $Kw. = \frac{Hp. \times 746}{Eff. \times 1{,}000}$. Assuming an efficiency of 0.80, then $Kw. = \frac{40 \times 746}{0.80 \times 100} = 37$. The efficiency will vary with the size and design of the machine, but 0.80 is a fair average value and is close enough for all practical purposes.

Taking Temperature Readings

The stator's temperature was measured externally on the iron with a thermometer, as indicated in Fig. 2, and was found to increase from air temperature to 207 deg. F., in one hour and twenty minutes. This temperature and load was carried in the excess of that indicated by good practice even for testing, but certain adjustments to the equipment were necessary before shutting down. The temperature should not be allowed to rise much above 175 deg. F. There is danger of the insulating compounds becoming brittle if the temperature exceeds 190 F. very long, which may cause insulation failures. As indicated on the motor test sheet, Fig. 3, the pump pulley was changed after the first five test readings and the last part of the test was made four days later and the speed was still somewhat above normal and the load was slightly in excess of rated full-load input, which for this motor (at the pul-

ley) would be about 37 kw., where the average input load was 39.5 kilowatts.

In addition to making such a test to remedy mechanical imperfections, an acceptance test may be desired to determine the conditions of power consumption, capacity and quality of work turned out for new equipment. Such a test is shown on the motor test record, Fig. 4. A careful check was made of the time and power



MOTOR TEST RECORD Page 311-312

40 H.P. General Electric MANUFACTURE

TYPE 1-4-434-780 FORM AMP. 50

780 R.P.M. SERIAL No. 122681 RECORD No. 923

DATE 11-2-18 11-6-18 LOCATION Bldg. 23 DRIVE Vacuum pump

CURRENT TRANS. RATIO 100:5 Amps. (20:1) CHART FEED 1-1/2 INS. PER HOUR

V.M.	Volts	A.M.	Amps.	K.V.A.	W.M.	P.F. Cycle	Kv.	H.P.	P.F.	R.P.M.	Cyc.	Inches Stator Deg. F	Time Lbs.	Pump R.P.M.	Remarks
218	426	4.6	90	66.9	3.10		62	82.1	93.8	827	30.10	15	135	10.30	429	This motor is connected to a high-speed centrifugal vacuum pump #2217. Rated speed 512 R.P.M.
218	424	4.7	94	69.0	3.15		63	84.8	91.8	817	30.10	13	160	10.45	424	
218	424	4.43	88.6	65.1	3.00		60	80.6	92.2	821	30.10	11	185	11.00	433	
219	420	4.32	86.4	62.7	2.875		57.5	77.0	91.8	821	30.10	7.5	198	11-16	407	
219	420	4.45	89.2	64.8	3.00		60.0	80.5	92.6	811	30.10	18	209	11-36	450	The result of the first five readings show that the pump is running over-speed and therefore takes too much power. The last five readings were taken after the pulley diam of pump had been reduced.
218	430	4.70	94	69.2	1.90		38	50.9	94.5	852	30.10	2			390	
212	424	3.85	58	47.6	2.25		45	60.3	94.8	856	30.2	18			396	
218	424	4.78	58	60.3	1.90		36	50.9	94.4	853	30.1	8			384	
218	422	4.70	94	60.4	1.90		38	50.9	94.3	184	30.1	4			387	
213	426	4.79	96.4	60.7	1.93		38.6	51.7	94.5	863	30.2	9.6			390	
								61.6 = MAXIMUM								
								53.6 = AVERAGE								Refers to last 5 readings taken from recording wattmeter chart.
								43.6 = MINIMUM								
								— No load								

Fig. 3—Record of tests made while load was being adjusted on motor

required to unload a certain volume of the material under normal operating conditions. The entire car was unloaded in 4 hr. and 50 min. The average power input, as obtained from the indicating scale of the recording wattmeter, was 50.9 hp. The method of making the material test was to take one-twelfth of the volume of the car as a convenient amount and to build a kind of cofferdam of planks around this volume of material. The net weight of the material in the car was 54,600 lb. as checked by the plant railway scales, and one-twelfth of 54,600 gives 4,550 lb. for the volume considered. The equipment was started and the suction nozzle was worked around into the material to secure a uniform load and the time was accurately noted for the unloading of this test quantity. After the standard unit time is established, the total time for unloading any given quantity may be obtained. An addition of about 10 per cent to the total power consumed must be made to allow for adjustments to equipment and idling time.

Data Obtained in Experimental Period

The average power was the approximate average shown by the recording meter chart, a sample of which is shown in Fig. 5. During the experimental period through which most new equipment must pass, the information for the cost department and production department as to the power billing and the possible economies or losses should be furnished by the electrical department tests. A large number of readings were not calculated or used in cases where the readings were practically duplicates of other readings.

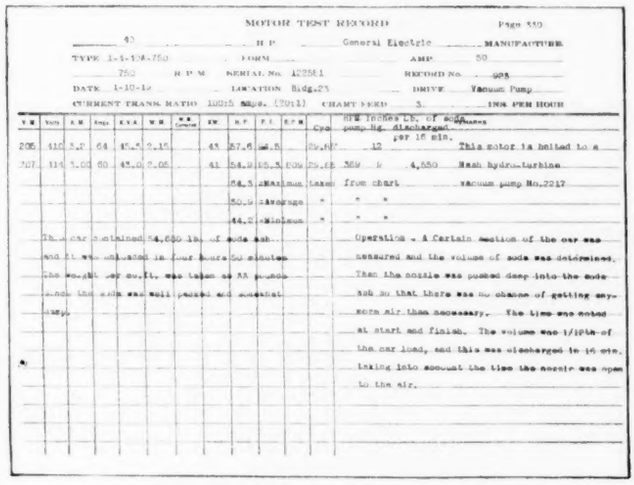
The reason for using one-twelfth of the carload for making the test instead of the whole was to avoid staying in the box car full of soda-ash dust for five hours. It was particularly desirable to get a proper manipulation of the suction nozzle and compare it with the everyday results, to show the difference between the best possible and the regular methods. In this case if the test conditions had been maintained the car would have been unloaded in 3 hr. and 12 min. ($12 \times 16 = 192$ min.), but as it was, it took 4 hr. and 50 min., and this is the time given on the test sheet.

The selection of the instruments is relatively simple where a sufficient range of current and potential values is provided. The voltmeter had a 300-volt scale, and a multiplier of 2 to 1 was used, giving a scale value of 600 volts. The ammeter was a 5-ampere scale instrument and the current-transformer ratio (100 to 5 amperes) was selected so that the full-load amperes would read about half full scale or over. During a test, where the load values may change or the light-load values must be read, it is necessary to change the ratio of the transformer in order to secure an accurate and legible reading, the lower divisions of the scale of alternating-current ammeters being crowded together. It is, of course, necessary to multiply the ammeter scale reading by the transformer ratio, which is 20 in this case.

The recording wattmeter in this case was provided with 5-ampere current coils, and the voltage coils were 440 volts and were connected directly to the circuit. The meter scale was graduated from 0 to 5 kilowatts and represents the fractional power of the primary circuit. To obtain the primary power the scale reading must be multiplied by the current transformer ratio and that product by the potential ratio. In this case the ratios are 100 to 5 and 440 to 440, therefore the wattmeter scale reading $\times$ 20 $\times$ 1 = primary kw. For any other circuit voltage than 440, suitable transformer would be required.

Using Test-Record Sheets

In the first left-hand column of the test-record sheets are recorded the actual voltmeter readings. In the second column are recorded the actual volts as obtained



MOTOR TEST RECORD Page 330

40 H.P. General Electric MANUFACTURE

TYPE 1-4-434-750 FORM AMP. 50

750 R.P.M. SERIAL No. 122561 RECORD No. 908

DATE 1-10-19 LOCATION Bldg.23 DRIVE Vacuum Pump

CURRENT TRANS. RATIO 100:5 Amps. (20:1) CHART FEED 3 INS. PER HOUR

V.M.	Volts	A.M.	Amps.	K.V.A.	W.M.	P.F. Cycle	Kw.	kw.	H.P.	P.F.	R.P.M.	Cyc.	Time Inches Lb. of soda pump Rg. discharged per 16 min.	REMARKS
206	410	5.0	64	15.5	2.15		43	57.6	96.5		29.97		12	This motor is bolted to a
207	114	5.05	60	45.0	2.05		41	54.9	95.3	806	29.98	369	0	4,550 Mesh hydro-turbine
								54.5	=Maximum	Load	from chart			vacuum pump No.2217
								50.9	=Average	"	"	"		
								44.2	=Minimum	"	"	"		
	The	car	contained	54,600	lbs.	of	soda	ash						Operation - A certain section of the car was
	and	it	was	unloaded	in	four	hours	50	minutes					measured and the volume of soda was determined.
	The	weight	per	cu.ft.	was	taken	as	55	pounds					Then the nozzle was pushed deep into the soda
	and	the	soda	was	well	packed	and	somewhat						so that there was no chance of getting any-
	lumps.													more air than necessary. The time was noted
														at start and finish. The volume was 1/12th of
														the car load, and this was discharged in 16 min.
														taking into account the time the nozzle was open
														to the air.

Fig. 4—Record of tests made to determine unloading time

by multiplying the voltmeter by the multiplier if one is used. In this case a multiplier of 2 to 1 was used, so that the volts indicated by the meter were only one-half of the line volts. Therefore the line volts given in the second column are obtained by multiplying the voltmeter readings given in the first column by 2.

Actual ammeter readings are recorded in the third column, and these readings multiplied by the current transformer ratio, in this case 20, are recorded in the fourth column. The latter is the actual current taken by the motor.

The kilovolt-amperes taken by the motor are recorded in column 5. On a three-phase circuit $Kva. = \frac{EI \times 1.732}{1,000}$, where E equals the line volts and I the amperes per terminal. On the first test the line volts are given as 426 and the current as 90 amperes, then $Kva. = \frac{426 \times 90 \times 1.732}{1,000} = 66.3$ kva., as given on the record. Under "W. M." are recorded the kilowatts as read from the recording wattmeter. If the meter has a calibration factor, the wattmeter reading is multiplied by this and the product recorded in the column "W. M. Corrected." The actual kilowatts are obtained by multiplying the wattmeter reading or the corrected reading by the multiplier, which in this case is 20, the current transformer ratio. The potential coil of the wattmeter is connected directly to the line, therefore these connections do not affect the multiplier. The horsepower input to the motor recorded in column "H.P." is obtained by multiplying the kilowatts by 1.34. In the first test, kilowatts equal 62, therefore $Hp. = 62 \times 1.34 = 83.1$ hp. To obtain the power factor recorded in column "P. F.", kilowatts are divided by kilovolt-amperes, or in the first test $62 \div 66.3 = 93.5$. The information in the other columns is self-explanatory.

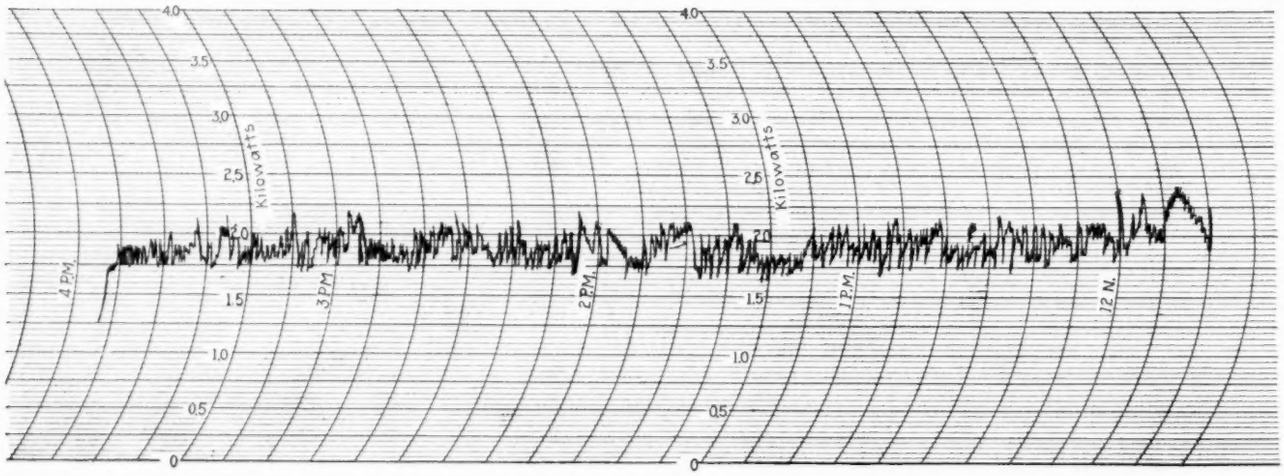


Fig. 5—Recording wattmeter chart showing power consumption

Changes in Frequency and Voltage

For an induction motor, rated at the speed that the one in question is, the power factors given in the record sheets are high. This can be accounted for in a number of ways. The motor is operating at its full load or slightly overloaded. The frequency is high, being 30 cycles instead of 25, for which the motor was designed. The voltage is also slightly below normal, being on an average about 425, compared to the rated voltage of 440.

Increasing the frequency will reduce the exciting current, consequently improve the power factor, but the torque will be reduced. A low frequency will result in an increased exciting current, consequently the power factor is decreased, the magnetic density in the iron is increased and this results in an increase in the torque. Since the speed varies directly as the frequency, an increase in frequency produces an increase in speed and a decrease in the frequency reduces the speed, but the per cent slip will not be changed.

When the voltage is increased, the power factor decreases below that for the same load on the motor and rated voltage, but the torque increases and the per cent slip is decreased. A voltage lower than normal causes an improvement in the power factor, but the torque is decreased and the per cent slip is increased.

When an ammeter, voltmeter and wattmeter are used to check the load on an induction motor, the power factor obtained from these readings is a good check on the correctness of the meter readings. If the voltage and frequency is normal and the power factor is high, then either the voltmeter or the ammeter or both are reading low or the wattmeter reading is high. There is probably a small error of this kind in the figures given in Figs. 3 and 4, but not enough to be of serious consequence.

Obtaining Speed and Frequency

The speed of the motor and pump was taken by a hand revolution counter and a stop watch by pressing the tip of the counter against the shaft at the instant the stop watch was started. On account of the frequency being high, about 30 cycles instead of 25, the speed of the motor is higher than the rated, corresponding to 25 cycles. The frequency was obtained in this case from the power-house switchboard meter and was read at regular intervals by the switchboard operator, as already mentioned. The temperature of the motor was taken by means of a mercury thermometer (a spirit thermometer should be used for higher voltage equipment) held against the stator iron and covered by means of a ball of glaziers' putty or it could be covered by wool waste. The vacuum was read by a mercury gage made from a ⅜-in. glass tube bent into a "U" shape and fastened to a white board which was marked off in inches drawn to half scale from the level of the two columns at atmospheric pressure on both tubes. A rubber hose connected one side to a pipe connection on the vacuum line.

Reconstructing a Refrigerating Plant

Problems Encountered in Enlarging Hotel Refrigerating System—Old Stack Too Small for Natural Draft—New Two-Stage Compressor Installed

By CHARLES L. MORGAN

THE refrigerating equipment in a large hotel included two 30-ton vertical compressors, of the twin-cylinder, single-acting type and another 10-ton unit of the inclosed type, all motor driven. The motors were originally placed at a considerable distance from the machines in order to provide proper center-to-center distance between the pulleys of the motors and the machines.

The two larger machines were operated on a brine tank and an ice tank. The brine tank served most of the refrigerators in the kitchen and also three large storage coolers.

WHAT would you do if you were ordered to enlarge a refrigerating plant at the minimum expense? The author relates how he tackled a similar problem and without increase in floor space doubled the capacity.

The small machine operated on a low suction pressure and worked by direct expansion on one freezer and an ice-cream hardening room, and was very much overloaded. As a matter of fact, part of the time the freezer was carried on one of the 25-ton machines at the high-pressure system suction pressure, which did not work out very satisfactorily.

About this time the management began considering the installation of a refrigerated drinking-water system, and refrigerated air for the main dining room and one of the ballrooms. The peak estimated load for this service was 75 tons. The next question that came up was where to place this unit.

The plant had originally been installed without the refrigerating equipment. The original power plant included a large reserve capacity both in boilers and power-generating units. When the refrigerating equipment had been installed, a very favorable contract had been secured for service from the local central station system and the refrigerating machines had been operated from this source for two years. At the end of this period the power company refused to renew the contract at the old rates, and the hotel owners, in order to continue the operation of the refrigerating machines, had installed an additional generating unit, which just about loaded up the boilers, although there was still considerable reserve capacity in the engine units.

There was space in the boiler room for an additional boiler, but there was no place in the engine room for the additional ice machine, which would have to be engine-driven, as the power units would be overloaded if the new refrigerating machine were motor driven from the present generators.

There was one objection, however, to adding more boilers. The stack was barely of sufficient capacity to handle the present load, and if more load was taken on, it was a question of whether the stack would be able to handle it or if another one would have to be added, which was not considered with very much favor by the owners.

This phase of the problem, however, was quite readily solved by installing hand stokers under the old boilers, in place of the old stationary grates. A new water-tube boiler was added to the boiler equipment, with a forced-draft underfeed stoker. In addition, forced-draft fans were installed for each of the old boiler units, and with this arrangement the chimney easily handled the increased load, with capacity to spare. It also provided liberal reserve capacity in the boiler room, as with the forced-draft arrangement on the old boilers it was possible to operate these at higher ratings and at increased efficiency, thus reducing the fuel consumption and at the same time increasing the capacity. The hand-operated stokers also added materially to this result, in fact made it possible to burn a lower grade of coal at considerably reduced cost of operation for any given period.

The next problem was to find room for the new refrigerating machine. To install the usual low-speed belt-driven machine with motor drive was out of the question. Various schemes were suggested for installing a vertical single-acting unit with a vertical engine, but even this was finally given up as out of the question.

How the New Condenser Was Installed

One of the watch engineers finally came out with a suggestion that with a few modifications was finally adopted. First close belt drives with idlers were installed on all the existing motor-driven machines. This brought the motors up close to the compressor at one end of the engine room.

At the opposite end was located the double-pipe ammonia condenser. There was liberal headroom in the engine room, as the ceiling was the same height as that of the boiler room, which had been laid out for water-tube boilers. A mezzanine concrete floor was now constructed on which the condenser for the new machine was erected and to which the old condenser was moved after the new one was placed in service. The condenser had to be reconstructed to 8 pipes high, instead of 12 as before, but this presented no serious difficulty. Forced-air ventilation was provided for the engine room, and the inlet air ducts for this ventilation entered back of the ammonia condensers in their new location, swept across this mezzanine floor and down into the engine room. This arrangement eliminated the pocket of stagnant hot air that otherwise would have formed

under the ceiling above the mezzanine floor and the ammonia condensers. The only objection to the arrangement was that if there was an ammonia leak on the condensers during the time the ventilating fan was in action, it would be all over the engine room on short notice. This, however, proved to be an advantage, as the men would get busy at once whenever they noticed the smell of ammonia coming with the air circulation, and this aided materially in eliminating the leaks and keeping the condenser tight.

A high-speed, engine-driven, horizontal double-acting compressor, of the two-stage type, equipped with clearance pockets, was now installed below the mezzanine floor, where the old condenser had been. With the rearrangement of the motor drives for the other compressors, in addition to the space provided by moving the condenser, there was now ample room for the compressor and also another brine cooler and the water cooler for the drinking-water system.

The new arrangement proved both economical and flexible. The new two-stage machine during certain periods of the year could practically carry the load alone by the use of the clearance pockets and maintain the proper temperatures for the ice-cream department and the storage freezer, which had been considerably enlarged while the reconstruction program had been going on. At other times the low-temperature load could be carried on the small 10-ton unit, which had been speeded up from 125 to 175 r.p.m., thus materially increasing its capacity. A larger motor had, of course, been added to take care of the extra power requirements of the plant.

A French High-Speed Diesel

By R. H. ANDREWS

THERE is a movement among some French experts favoring the use of solid injection for all types of internal-combustion engines, from the high-powered Diesel down to the gasoline engine for automobile drive, regardless of the fuel employed. The advantages claimed include the possibility of using higher compression pressures, with the resulting improvement in efficiency. This is possible because the mixture of the injected fuel with the air is imperfect and, therefore, unfavorable to the production of the detonating wave, even with volatile fuels. In addition there is the possibility of using a much wider range of fuels. It is claimed by advocates of fuel injection that, in order to secure a satisfactory mixture with a carburetor, it is essential to use a fuel of approximately homogeneous physical constitution; that is, all the elements should vaporize over a limited range of temperatures, whereas injected fuels may include elements differing widely in boiling points. Whether these advantages will be sufficient to displace the carburetor remains to be seen. It does not seem likely, however, that injection will ever be used with gasoline alone.

Lightest Oil Engine Built

The Peugeot-Tartrais oil engine is interesting primarily as the lightest oil engine built, weighing only 11 lb. per horsepower, and it is first to undergo a successful road test in automobile drive. In October, 1922, a five-passenger touring car driven by this engine completed a 700-mile run in two days. The fuel consumed was gas oil, and the mileage per gallon of oil about 14¾ miles.

This engine is also particularly instructive, not only because of a number of novel features in its design, but because of the curious story of its development. It was originally planned as a semi-Diesel, or hot-bulb, engine built for the closest possible approach to constant-volume combustion, and was subsequently modified so as to bring it within the Diesel class.

The original idea of the inventor, Tartrais, was to develop a surface-ignition in which the mixture of air and oil vapor could be made sufficiently homogeneous before ignition to give a high rate of flame propagation. For this purpose the combustion chamber was made of peculiar shape and was connected to the cylinder proper by a bottle-neck opening. The piston face was provided with a projection, or nose, which, on dead center, extended about halfway through the bottle neck. The nose was so shaped that during the latter part of the compression stroke the air was forced at high velocity between the piston nose and the walls of the bottle neck and also through oblique holes drilled through the nose. This and the shape of the combustion-chamber walls produced a high state of turbulence during the injection of the fuel. The latter was injected mechanically in a horizontal plane at right angles to the axis of the bottle neck, so as to be swept up by the stream of inflowing air and rapidly mixed with it.

The compression pressure was about 280 lb. per sq.in. and the maximum pressure during combustion about 450 lb. An electrically heated plug comprising a platinum resistance wire, was provided for starting. The model built had two cylinders and operated on the two-stroke cycle. The scavenging air was supplied at about 5 lb. gage by a separate scavenging pump.

Fuel Consumption Low

The fuel consumption was reported as 0.4 lb. of gas oil per b.hp.-hr., a surprisingly low figure hardly ever reached in Diesels.

Though technically satisfactory in most respects, the design proved so complicated as to make the production cost of the engine prohibitive. The engine was then carefully gone over and it was first decided to water-cool the walls of the combustion chamber in order to increase their strength. This made it necessary to raise the compression volume ratio to 12 in order to bring the mixture to the temperature of auto-ignition. The resulting increase in the compression pressure to 475 lb. made a high degree of turbulence in the mixture undesirable, in order to avoid excessive combustion pressures. It was therefore possible to discard the nose on the piston face, resulting in a material reduction in the production cost of the latter.

These changes, together with the simplification of the treatment of the lubrication problem, constituted the principal modifications in the original design. The fuel consumption of the new engine is about 0.45 lb. per

b.hp.-hr. at full load. The smoothness and regularity of operation have not been impaired, and the reliability of the engine has probably been increased. The compression pressure being somewhat too low for cold starting, the starting plug was not discarded.

A cross-section of the new Peugeot-Tartrais engine, as it is to be placed on the market, is shown in Fig. 1, while Fig. 2 shows a cross-section of the fuel pump.

The only type to be built at first is a two-cylinder, two-stroke-cycle motor truck engine, 50 to 55 hp. maximum at 1,400 r.p.m. The cylinder dimensions of this engine are 4.73 in. bore and 5.906 in. stroke. The scavenging air is supplied by a separate piston-type air pump which is located between the engine and fan. The pump also produces a slight degree of supercharging, through the medium of a revolving valve placed at the outlet from the exhaust manifold, which is timed to close the exhaust when the cylinder is free of burnt gases.

When the Tartrais engine is running at rated speed, 1,400 r.p.m., and under maximum load, each of the two pump cylinders must deliver 23 times per second a volume of about 0.004 cu.in. of oil, the maximum length of the delivery stroke being less than 0.08 in. The volume is so small that the greatest care must be exercised to reduce to a minimum the compressibility of the oil, by avoiding the leakage of air into the fuel circuit, and particularly the formation of bubbles of vapor, under the extremely rapid fluctuations of pressure to which the oil is subjected.

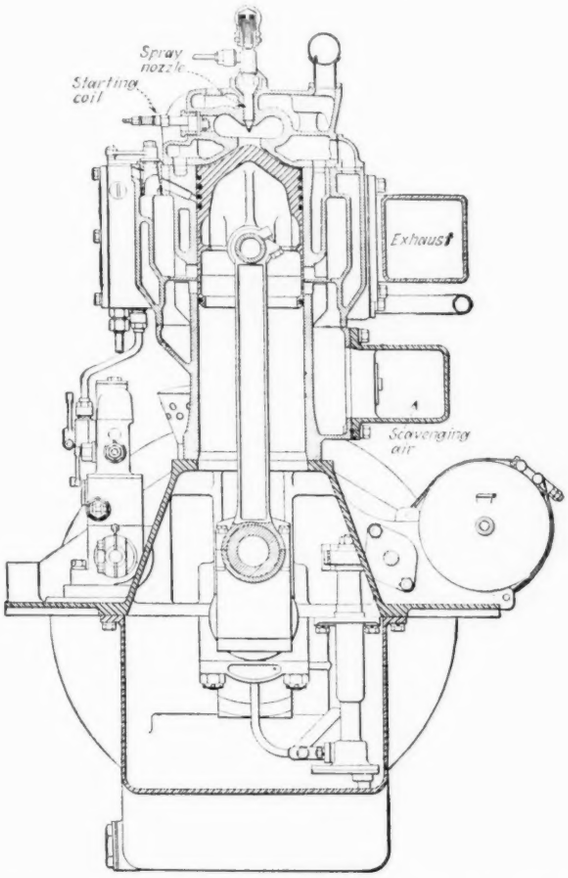


Fig. 1—Cross-section of Peugeot-Tartrais engine

The suction stroke of the fuel pump is altered to meet the load by a stop, which has a long-pitch screw thread and may be revolved by a worm and gear operated by the fuel-regulating rod. The time of injection may be adjusted by means of a sliding sleeve coupling connecting the camshaft to its driving gear through the medium of a helical groove. The Peugeot company is planning a series of engines for stationary and marine service, of 50 hp. per cylinder in multiple-cylinder units.

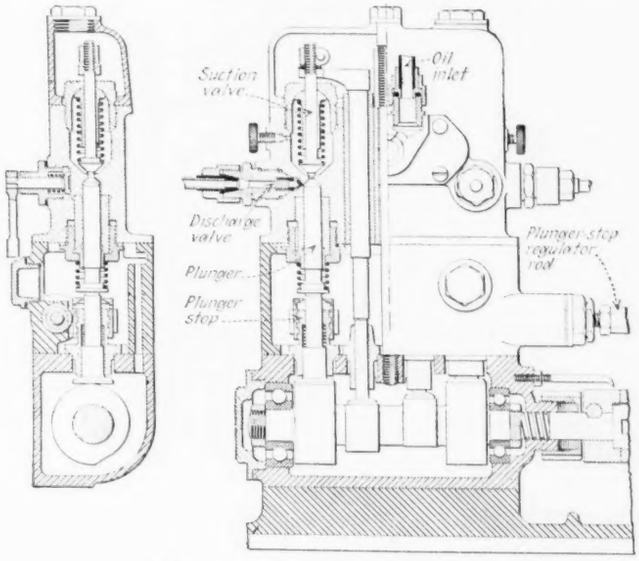


Fig. 2—Fuel pump assembly

The following from the serial report on "Stokers and Furnaces," Prime Movers Committee, N.E.L.A., refers to the experience of the Commonwealth Edison Company with air preheaters. This company has in service heaters of both the plate type and the tubular type. Referring to the former, which was put into regular operation in October, 1923, the following statement is made:

To date no repairs of any kind have been required, and when recently inspected, the plates all appeared to be practically as good as when installed. We have had some difficulty in keeping the area at the entrance at its full opening. The soot would collect at the bottom on the spacer bars between the sections because the heater is installed in a horizontal position with a soot hopper under only about one-third of it. This deposit is raked and scraped out about every two to three months. The plates themselves are usually quite clean. No great amount of soot collects, as the expansion and contraction of the plates causes it to break or scale off. We do, however, wash the plates about every 10 to 14 days.

The tube heater was put into regular operation on June 2, 1924. On Feb. 28, 1925, a tube was removed for inspection. So far as could be seen, the tube was practically the same as the day it was put in, no corrosion being noticed. No repairs have been necessary to date. The heater is washed with water about every month. At the time of washing, the gas surface (inside of the tubes) is quite dirty. This preheater is not washed more often because it is not equipped with regular washing elements and must be washed by using a hose. This heater is installed in a vertical position.

Self-cooled transformers should always be separated from one another and from adjacent walls, partitions, etc., in order to permit free circulation of air about the tanks. This separation should not be less than 24 to 36 in., depending on the size.

Some Florida Oil-Engine Plants

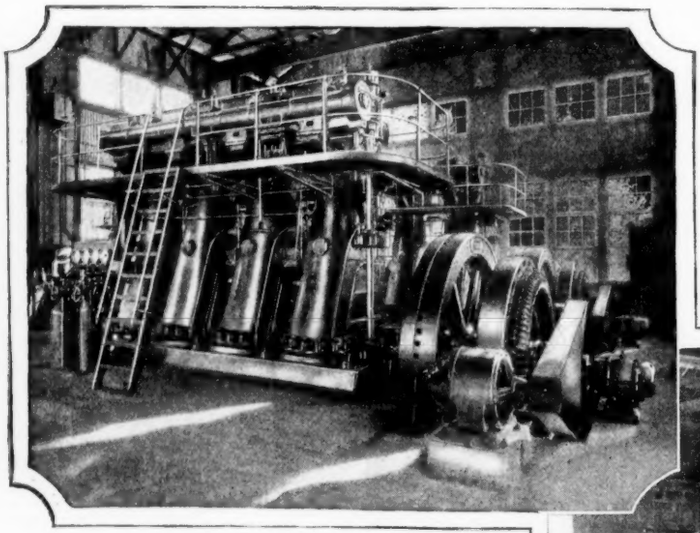


Fig. 1 (left)—Two 330-kw. Diesel units supply Fernandina with electricity

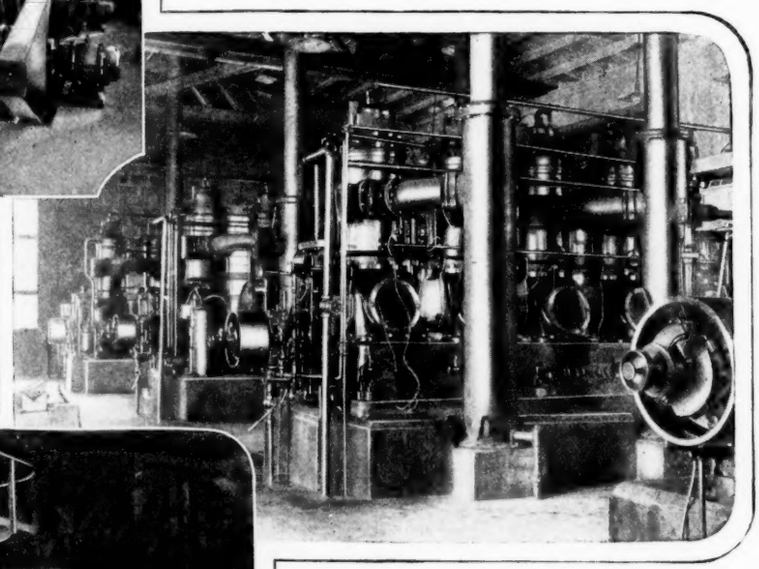


Fig. 2 (below)—A 400-hp. Diesel being erected at Vero

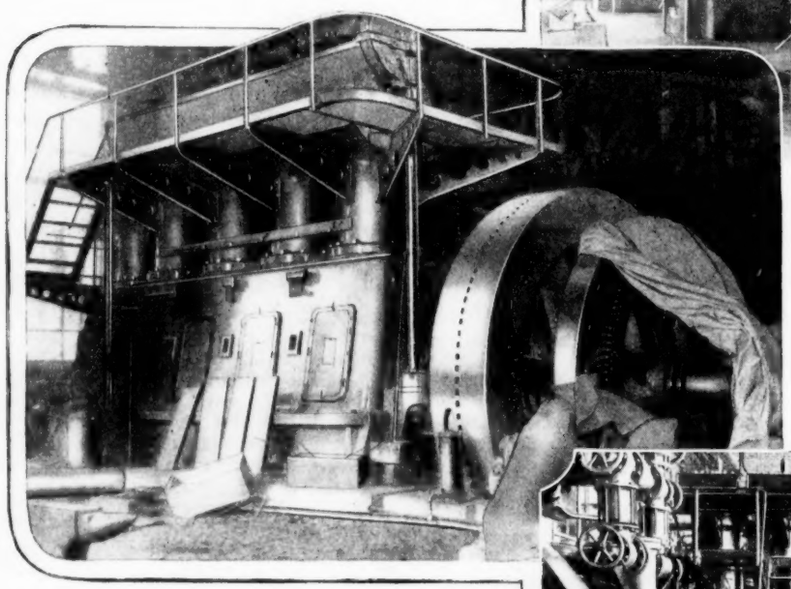


Fig. 3 (above)—Four two-stroke-cycle engines and a 1,150-hp. air-injection Diesel at Hollywood

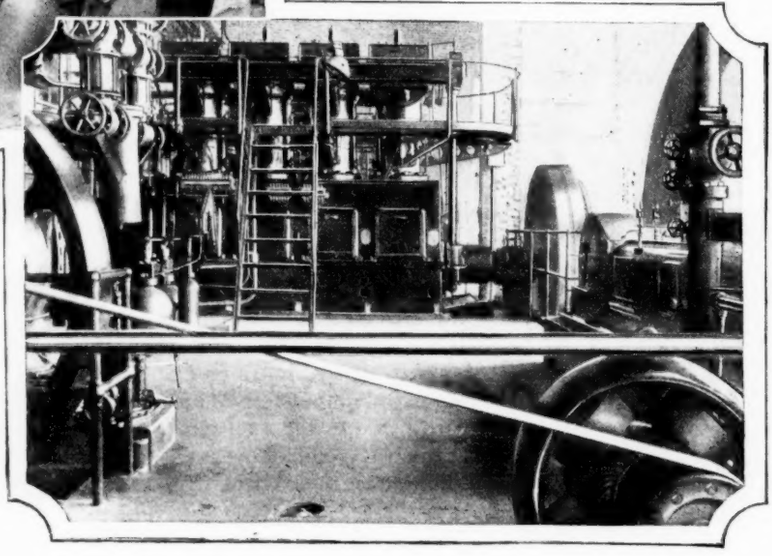


Fig. 4 (left)—A 400-hp. Diesel in the plant of the Citizen's Ice Co., St. Petersburg

*Boiler Feed-Water Purification—V**

Hot-Process Continuous Softeners

Various Types—How Constructed—How Operated—Relative Merits of Hot and Cold Softeners

By SHEPPARD T. POWELL
Consulting Chemical Engineer, Baltimore, Md.

HOT-PROCESS chemical softeners are essentially the same as cold softeners of the continuous type except that the softening process takes place in a hot solution. This form of treatment is a fairly recent development and possesses a number of inherent advantages over cold softeners. The apparatus is a combination of an open feed-water heater and softener in which the scale-forming solids are removed in part by the effect of heat and in part as the result of chemical reaction. The velocity of chemical reactions is more rapid in hot than in cold solution and the insoluble compounds formed settle more rapidly and are more completely removed.

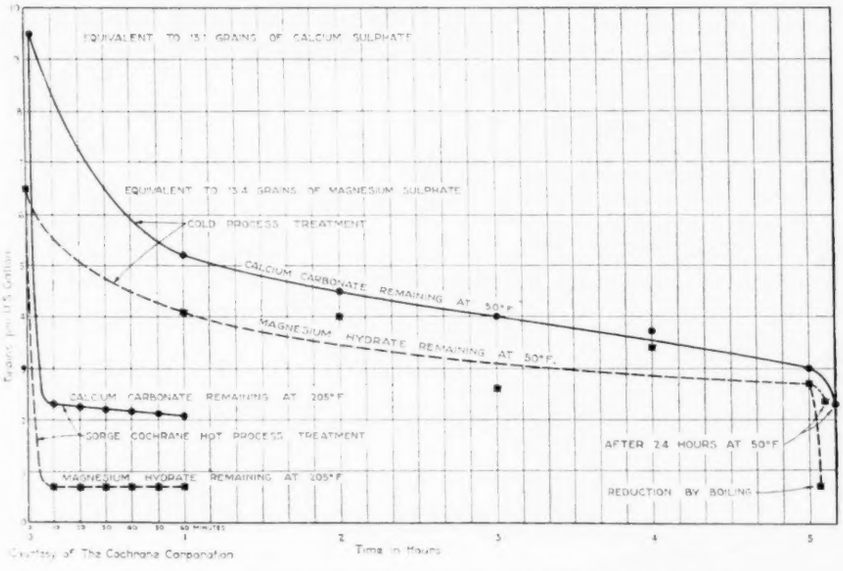

EQUIVALENT TO 13.1 GRAINS OF CALCIUM SULPHATE
EQUIVALENT TO 13.4 GRAINS OF MAGNESIUM SULPHATE
COLD PROCESS TREATMENT
CALCIUM CARBONATE REMAINING AT 50°F.
MAGNESIUM HYDRATE REMAINING AT 50°F.
CALCIUM CARBONATE REMAINING AT 205°F.
GORGE COCHRANE HOT PROCESS TREATMENT
MAGNESIUM HYDRATE REMAINING AT 205°F.
AFTER 24 HOURS AT 50°F.
REDUCTION BY BOILING
Grains per U.S. Gallon
Time in Hours
Courtesy of The Cochrane Corporation

Fig. 1—Showing the effect of heat on the precipitation of calcium and magnesium

The rapidity of chemical reaction, although studied by a number of investigators, has not been established definitely. It is known, however, that the velocities of the reactions are increased tremendously as the temperature of the water increases. This condition is demonstrated graphically in Fig. 1. From these results it will be noted that the reduction of the non-carbonate hardness is greater in treated water heated to 205 deg. F. after settling ten minutes than results in treating water at 50 deg. and permitting the solids to settle for five hours. The chart shows also that even after five hours settling in the cold process the calcium and magnesium salts may be reduced still further by the application of heat.

The essential features of a hot softener are: (a) The heater for raising the temperature of the raw water to 200 deg. F., or higher; (b) the chemical dosing apparatus; (c) the subsidence and reaction tank; (d) the filter.

A number of hot softeners have been placed on the market within the last few years. They differ from one another primarily in the construction details and in the method of heating the water. Exhaust or live steam may be used. Exhaust steam is used in most installations, but the heaters are designed to function under a few pounds back pressure.

In Fig. 2 is shown the general arrangement of a hot softener that has been widely used for treating feed-water supplies. The water enters the softener at the top of the apparatus and is heated to a temperature ranging from 205 to 212 deg. F. by means of exhaust steam. The heater is cast iron and is equipped with an oil separator. Heating of the water is accomplished by spraying it over trays. This releases the majority of the carbonic acid, thereby causing the precipitation of the carbonates of calcium and magnesium. Here also is released much of the dissolved oxygen or other gas that may be contained in the raw water supply.

The chemical reagents are added as the water flows into the subsidence chamber. Owing to the high temperature, the solids are precipitated rapidly into the conical hopper bottom of the tank from which they are removed as desired by blowing down. The soft water, with the solids that have not settled, passes upward in the take-off funnel. The softened water is passed through a pressure filter where the suspended solids are removed, after which the clarified soft water is discharged directly to the feed-water pumps or to a storage tank.

The chemical-solution tank and chemical proportioning or dosing apparatus are on the ground level. The chemical proportioner feeds the solution at a rate proportional to the flow of raw water entering the apparatus.

*Previous installments have covered the following subjects: July 6, "Natural Waters and Their Impurities"; July 13, "Getting Rid of Impurities by Sedimentation and Coagulation"; July 20, "Filtration by Gravity and Pressure Filters"; July 27, "Softening Water by Chemicals."

One of the special features of the apparatus is the uptake funnel through which the soft water passes from the softener. The design of the funnel is based on the principle that the flow of water downward is changed from vertical to horizontal in passing under the rim of the cone. As a result of this operation the heavier solids continue to settle in the hopper bottom and only the finely divided particles are carried upward with the water as it leaves the apparatus. These solids are so small that they require a long subsidence period for their removal and it is preferable to effect their removal by filtration. The funnel arrangement permits of a minimum amount of space for the discharge and a maximum settling capacity in the tank. Most solids settling upon the outside of the funnel will slide down and be discharged over the edge into the hopper.

The filter is back-washed by soft water delivered from the sedimentation chamber of the softener. The wash water may be returned to the softener or discharged to the sewer. During the time the filter is being back-washed or whenever it is desired, soft water may be discharged to the feed-water pumps without being filtered.

Another Design of Hot Softener

Another design of hot softener is shown in Fig. 4. The feed-water heater and oil separator are situated on top of the sedimentation tank. The water is heated by exhaust steam and is discharged from the heater into the mixing and subsidence tank. The special feature of this softener is the arrangement of the annular downtake compartment and the central uptake. These two compartments have the same capacity so that the time of flow downward in the outer compartment and that upward in the center compartment should be equal. Convection currents, which hinder settling of the precipitate, are reduced by this arrangement.

The chemical dosing apparatus and the pressure filter, as indicated in Fig. 5, are placed on the ground level. The chemical is applied in amounts proportional to the flow through the apparatus. The filter is back-washed with hot soft water and the wash water is returned to the softener, where the suspended solids removed from the filter medium settle with the precipitated solids in the treated water.

Operation of Hot Process Softeners

It is essential that the sludge compartment of the softener be of sufficient size to hold the precipitated solids between blowdowns. Most softeners on the market today are designed to hold the sludge that will accumulate in the bottom of the softener for eight or more hours without danger of being entrained in the stream of soft water flowing from the apparatus. Sometimes an excessive amount of suspended solids is carried from the softener, but this condition is the result, usually, of lax operation in the frequency or method of sludge removal.

Removal of the sludge from softeners is an important item for efficient operation of either hot or cold softeners. Failure to blow down hot softener causes the filter to be cleaned more often and places an unnecessary load on this apparatus. Exaggerated cases have resulted in failure of filters to function, causing the filter material to become so loaded with suspended solids that complete clarification has been impossible. Too frequent blowing down of softeners wastes heat and is unduly costly.

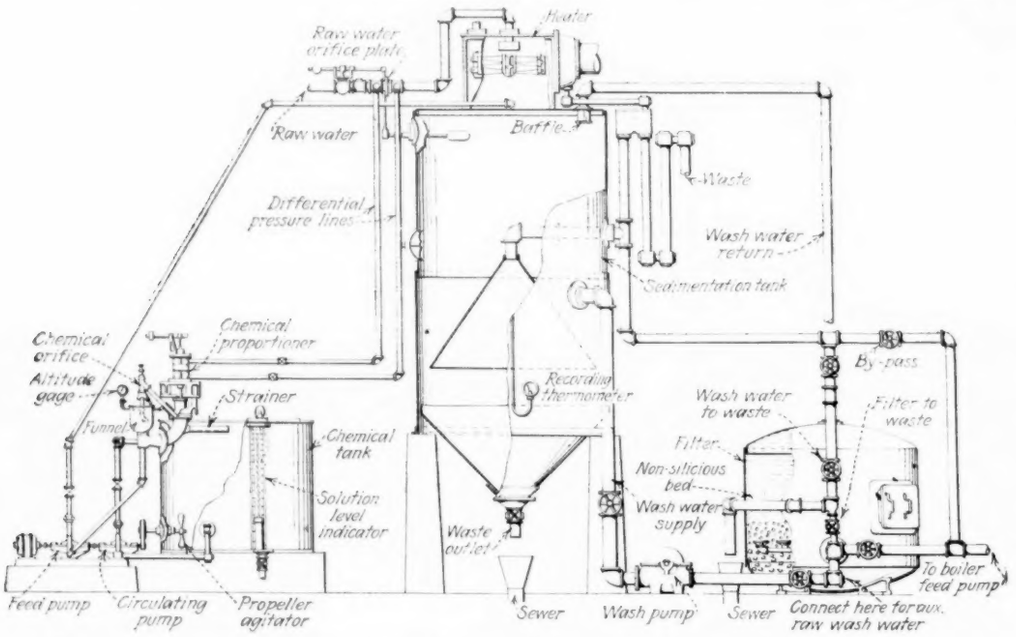


Fig. 2—General arrangement of a hot-process chemical precipitation softener (Cochrane)

The frequency of blowdown periods should be governed by the volume of water softened and the amount of sludge produced. When treating water the composition of which does not change materially, a regular blowdown cycle may be determined. The operation of softeners employing a raw water whose mineral content is subject to change, requires varying blowdown periods. A sample of the blowdown water should be tested at the end of the operation. The water taken from the sludge pipe should contain no appreciable amount of solids at the end of the blowdown.

A convenient method for determining the condition

of the blowdown water is to take a sample and permit it to settle in an Imhoff cone for fifteen minutes. If the majority of sludge has been discharged from the tank, only a small amount of sediment will collect in the apex of the cone. Fig. 3 shows the amount of sediment collected from the blowdown water after fifteen minutes' settling. Cone *B* represents the amount of sediment

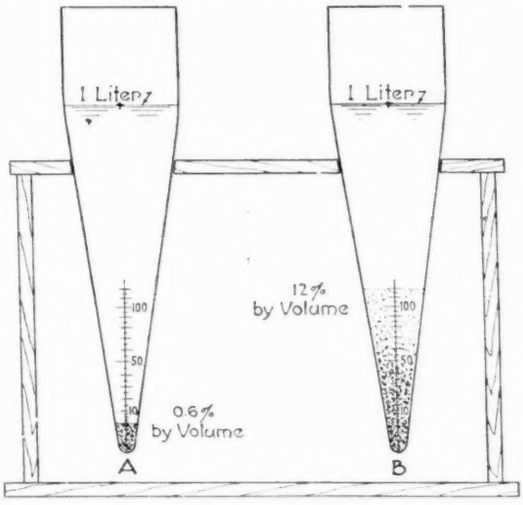


Fig. 3—Imhoff cone test for solids in blowdown water
A—Indicates efficient blowdown; *B*—Indicates inefficient blowdown.

collected when the softener was blown down for an insufficient time and cone *A* after the softener had been properly blown down.

For a number of years sand or other siliceous materials were used as filter media in apparatuses for clarifying treated water from hot-process softeners. Recent studies have demonstrated that hard dense scale has formed in boilers due to the formation of calcium silicate as a result of the passage of the hot alkaline solution through the siliceous filter. To overcome this difficulty, magnetite, calcite and other substances not affected by hot alkaline solution are being employed for the filter medium in place of sand.

TABLE I—EFFECT OF FILTER MEDIUM UPON COMPOSITION OF BOILER SCALE

	Sand Filter, Per Cent	Magnetite Filter, Per Cent
Calcium silicate	85.80	none
Calcium carbonate	none	90.80
Magnesium hydrate	5.90	0.50
Iron oxide and alumina	3.06	3.30
Silica	none	4.10
Volatile and organic	5.11	0.80
	99.87	99.50

TABLE II—EFFECT OF TREATMENT IN HOT-PROCESS SOFTENER UPON ANALYSIS OF WATER*

	Before Treatment, Raw Water		After Treatment, Soft Water			
			Sample 1		Sample 2	
	P.P.M.	G.P.G.	P.P.M.	G.P.G.	P.P.M	G.P.G.
Organic and volatile	46.8	2.74	28.5	1.67	36.9	2.10
Silica	2.9	0.17	5.1	0.30	2.9	0.17
Iron and alumina	trace	trace	trace	trace	.....	trace
Calcium carbonate	134.9	7.89	14.7	0.86	5.9	0.35
Calcium sulphate	140.0	8.12	none	none	.....	none
Magnesium carbonate	35.9	2.10	none	none	.....	none
Magnesium hydrate	.....	.....	1.5	0.09	2.9	0.17
Magnesium chloride	13.0	0.76	none	none	.....	none
Sodium carbonate	.....	.....	15.0	0.88	64.8	3.79
Sodium hydrate	.....	.....	20.8	1.22	10.0	0.64
Sodium sulphate	.....	.....	229.1	13.40	187.2	10.95
Sodium chloride	.....	.....	20.8	1.22	15.0	0.88
Sodium nitrate	10.1	0.59	9.2	0.58	10.9	0.58
	383.6	22.37	344.7	20.22	336.5	19.63

* P.P.M. means parts per million and G.P.G. grains per U.S. gallon. One G.P.G. equals 17.1 P.P.M.

Scale taken from boilers fed with water that had been treated in a hot-process softener, but filtered in one case through a sand filter and the other case through a magnetite filter, showed the results given in Table I. Note the marked effect of the sand.

The size of the filter to be used in conjunction with hot-process softeners should depend upon the maximum rate at which the softener is to be operated. The design and operation are essentially the same as with pressure filters used for the clarification of cold water.[1] The principal difference is in the choice of filter material used and in the disposal of the waste water. In filtering cold water it is customary to discharge the waste water to the sewer, while in filters for use with hot softeners the wash water is returned usually to the sedimentation chamber of the softener.

The hardness of water may be reduced by hot softeners to from 2 to 3 grains per gallon and even lower by careful control. Table II gives the results of analyses of samples of water taken before and after treatment by a hot process softener.

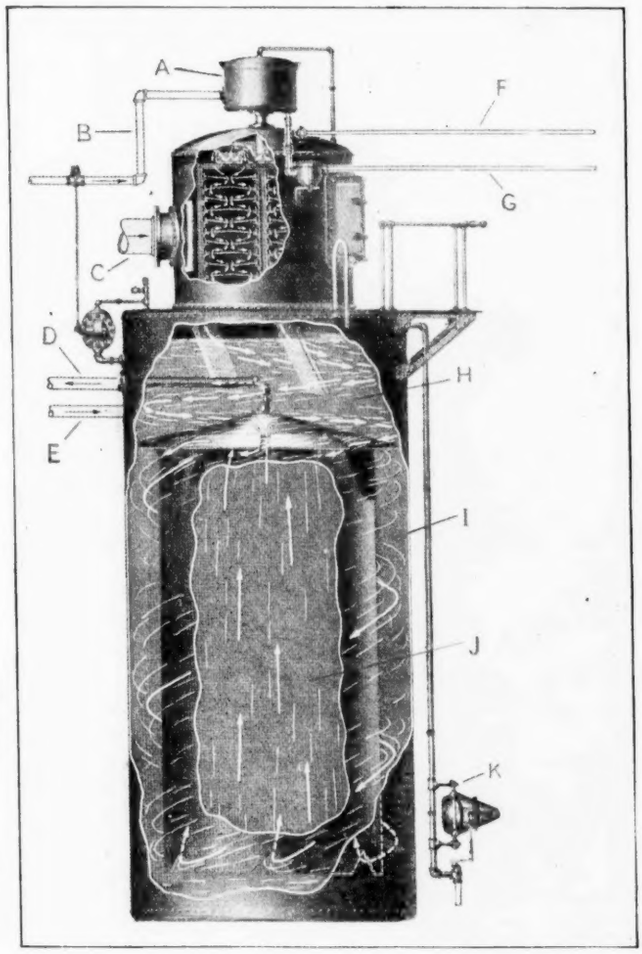


Fig. 4—Heater and softening unit of a typical hot-softening chemical precipitation plant (International Filter Co.)

Much has been written concerning the relative merits of cold- and hot-process softeners. Unfortunately, some of these discussions have been biased in order to set

[1] See third installment, in July 20 issue.

forth the advantages and disadvantages for specific reasons. Hot-process softeners possess a number of advantages over cold softeners. The choice of a particular system should be based, however, upon local conditions, which may be influenced by many factors. Some of the advantages of hot-process softeners are given herewith.

1. Combination of feed-water heater and softener in one apparatus.

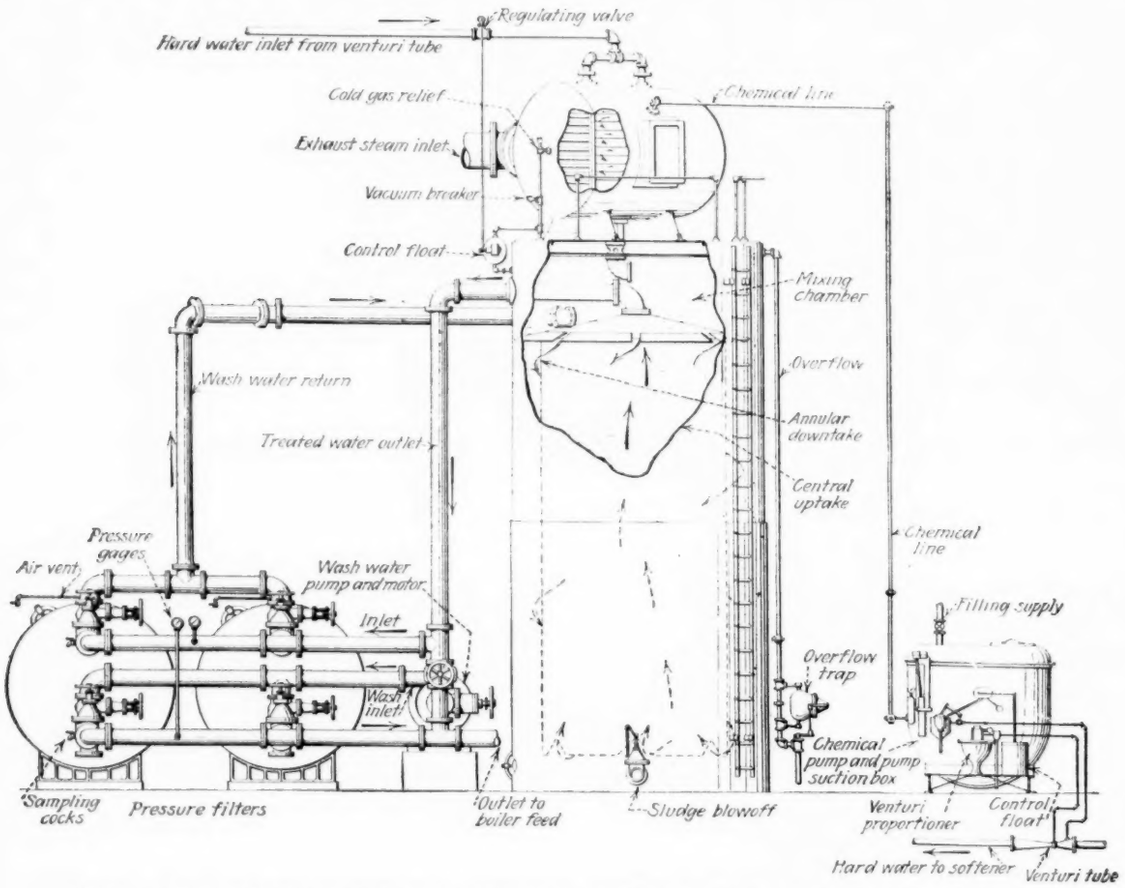


Fig. 5—General arrangement of hot-process softening plant (International Filter Co.)

2. Reduction of scale-forming solids to 2 grains per gallon or less.

3. Less troubles from after deposits in boilers and appurtenances.

4. Elimination of dissolved gases, thereby reducing the corrosive properties of the water.

5. Apparatus required is smaller than that used in the cold process on account of the rapid rate of precipitation of lime and magnesium salts at high temperatures.

6. Hot softeners may be installed frequently within the boiler room, thus saving the cost of special housing.

The proper amounts of chemicals required to soften water either in hot or cold softeners may be determined only by analyses of the raw water. A number of schemes for calculating the approximate amounts of chemical reagents required have been devised by different manufacturers and chemists. All these formulas are based on the reacting weights. A simple method of computing the required amount of softening reagent, recommended in the "Manual of American Water Works Practice" is transcribed herewith.

1. The sum of the free and half-bound CO_2 (expressed as parts per million) multiplied by 0.0106 = pounds of CaO (lime) per one thousand gallons necessary to absorb the free and half-bound CO_2.

2. Total magnesium (expressed as parts per million) multiplied by 0.019 = pounds of CaO per one thousand gallons necessary to precipitate the magnesium.

Soda ash required (pounds of Na_2CO_3 per one thousand gallons) to remove non-carbonate hardness is computed as follows:

Non-carbonate hardness (expressed in parts per million minus the quantity of non-carbonate hardness that it is desired to leave in the water) multiplied by 0.009 = pounds of Na_2CO_3 required per one thousand gallons.

It is customary in the operation of softening systems to add a slight excess of soda over the amount that is theoretically required for the reaction, in order to insure removal of the non-carbonate hardness. The amount of excess soda used should be controlled carefully, since difficulty may be experienced from high concentrations of these salts.

After an armature is dipped in baking varnish and removed, it is essential that the excess varnish be allowed to drain off before baking. If this is not done and the armature is baked in a horizontal position, the excess varnish will run to the low side and harden, thus throwing the armature out of balance. Before dipping, the armature should be baked in an oven at a temperature of about 200 deg. F. for ten to twelve hours and then left in the baking varnish for about fifteen minutes, or until bubbles cease to rise to the surface of the varnish. The baking process should be carried on for about 72 hours at 200 deg. F.

Elevators and Conveyors for Coal Handling*

By W. W. SAYERS
Chief Engineer, Link Belt Company, Chicago

SUMMARY of conditions governing the selection and application of centrifugal-discharge and continuous-bucket elevators, flight and screw conveyors.

THE engineer who may be laying out a coal-and-ash system today, has many methods from which to choose. He should be able to select equipment that will most efficiently meet his peculiar condition. In this connection it will be helpful to review the different types of equipment, and mention a few of the conditions governing their application and selection.

Fig. 1 illustrates a centrifugal-discharge bucket elevator, which consists of malleable iron buckets, spaced at intervals on one or two strands of chain, and running at a speed of about 200 to 300 ft. per min. The coal or ash is delivered into a boot, from which it is scooped up by the buckets, elevated and discharged or thrown by centrifugal force, while passing over the head sprocket, into a chute leading to an overhead bin or to a conveyor for distribution to a long continuous bin.

*This is the second of a series of five articles, the first of which appeared in *Power* last week.

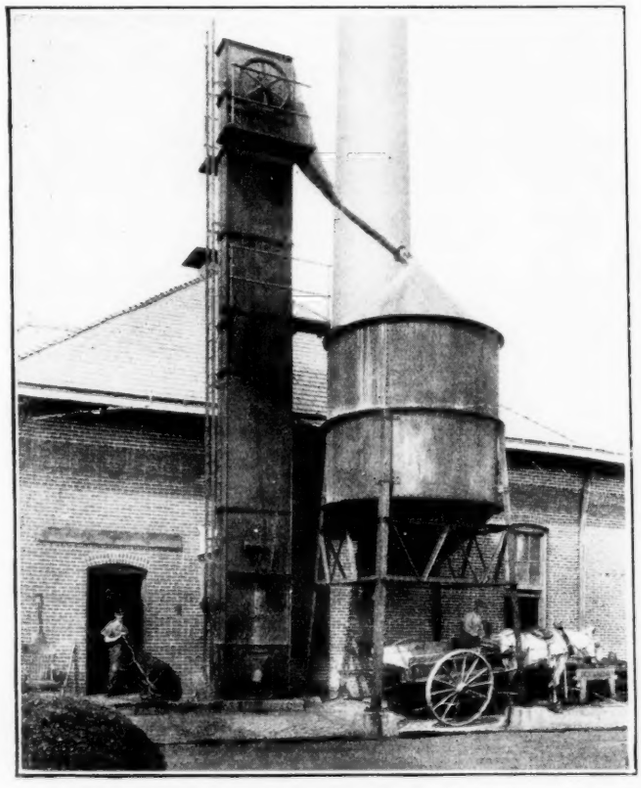


Fig. 1—Centrifugal discharge bucket elevator

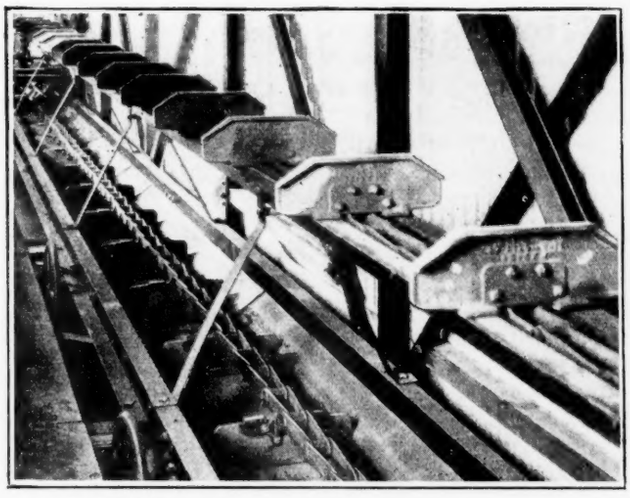


Fig. 2—Single-chain flight conveyor

When handling coal, malleable chain is commonly used; but the abrasive nature of ash calls for manganese or malleable chain provided with hardened pins and bushings.

This was one of the first types of elevating units developed, and it is still commonly used where the quantities of material handled range from 10 to 30 tons an hour, where conditions do not warrant providing heavier and more expensive equipment, and where the operation is intermittent.

Continuous Bucket Elevators for Coal

Continuous bucket elevators, used for elevating coal where conditions justify, provide more expensive and dependable equipment than the centrifugal-discharge bucket type for capacities ranging from 20 to 100 tons an hour. As they are not suitable for ash, their application is restricted to elevating coal and discharging it into overhead bins or to distributing conveyors both in and outside the power plant.

Steel buckets spaced close together, slightly overlapping, are attached to single or double strands of chain, depending upon the size of the buckets and the vertical lifts of the elevator. The buckets discharge their contents by gravity and are so constructed that the front of one bucket forms a chute for the discharge of the material from the next succeeding bucket, thus preventing the material from falling down the elevator leg.

It was developed to fill the need of a better elevating unit than the centrifugal discharge bucket type; having greater capacities, at slower chain speeds of from 60 to 140 ft. per min. The buckets are usually loaded from a chute leading directly to them on the ascending run, just after they have passed around the foot sprockets. Ordinarily, continuous buckets are not suited for digging or loading at their bottom position in the boot,

although they can be loaded in this manner by employing special buckets and boot.

Flight Conveyors

The flight or pusher type of conveyor was developed as a means for distributing the coal horizontally or elevating at angles from zero to approximately 45 deg. The coal is received in a trough, pushed along by flights spaced at intervals, and usually discharged through openings in the bottom of the trough, provided with gates to be opened or closed as conditions require. The early conveyors of this type consisted of a single strand of chain, Fig. 2, with flights attached at intervals, scraping and conveying material along the bottom of the trough.

The need for conveyors of this type of greater capacities was met by providing two strands of chain attached to the ends of the flights. They were further improved by the use of rollers suspending the chain and flights, instead of permitting them to drag on the bottom of the trough, and by double strands of chain with rollers at the articulation joints, to carry the chains and flights, as in Fig. 3.

Ordinarily, the upper and lower horizontal runs of flight conveyors are spaced the diameter of the sprocket apart, but where conditions require, the material may be carried over and discharged into a bunker or to ground storage; be withdrawn from the bunker or ground storage into the lower horizontal run and discharged at the end or at intermediate points of the lower run, by simply having the conveyor encircle the storage.

It is a useful type and is quite generally used, especially where it is desirable to convey and elevate the material at the same time at inclinations greater than 20 deg., the maximum inclination at which a belt conveyor ordinarily can be used. In addition to being less expensive than the belt conveyor, it can be used where there is not sufficient space to permit installing the latter and where there is insufficient room to permit a traveling tripper for distributing the material.

Flight conveyors are not suitable for handling abrasive materials such as ash, as the sliding or scraping action rapidly wears the trough lining. They operate at speeds up to 150 ft. per min. and have capacities ranging from 10 to 500 tons per hour and are suitable for either lumpy or small coal.

Development of the Gravity-Discharge Elevator

As the conveying and elevating art progressed to the point where the "centrifugal discharge" and "continuous bucket" elevators had been developed for elevating and the flight conveyor for distributing the materials horizontally or at inclinations up to 45 deg., engineers appreciated the desirability of a single unit for accomplishing both the elevating and distributing operations. The gravity-discharge elevator was designed and built to accomplish this purpose and has come into a wide use.

As shown in Fig. 4, it consists of buckets, approximately V-shaped in cross-section, attached at intervals between two strands of chain. Coal is received in a boot, from which is is scooped up by the buckets in passing around the foot wheels and is elevated to the desired height, where the buckets turn around wheels from a vertical to a horizontal position. The buckets then push the coal along a steel trough and discharge

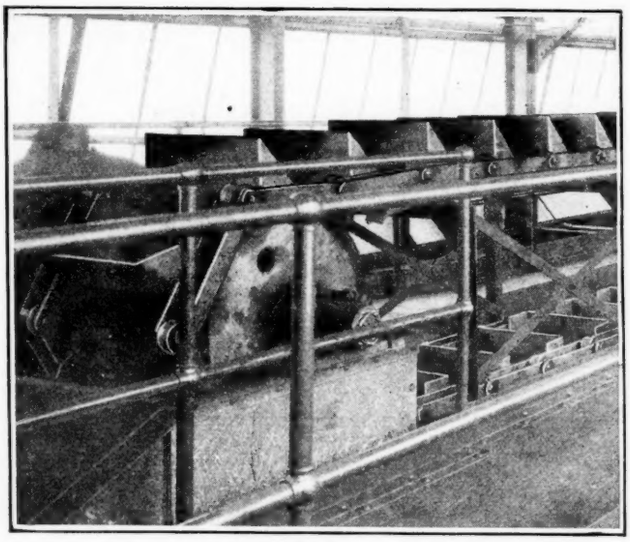


Fig. 3—Double-chain roller type of flight conveyor

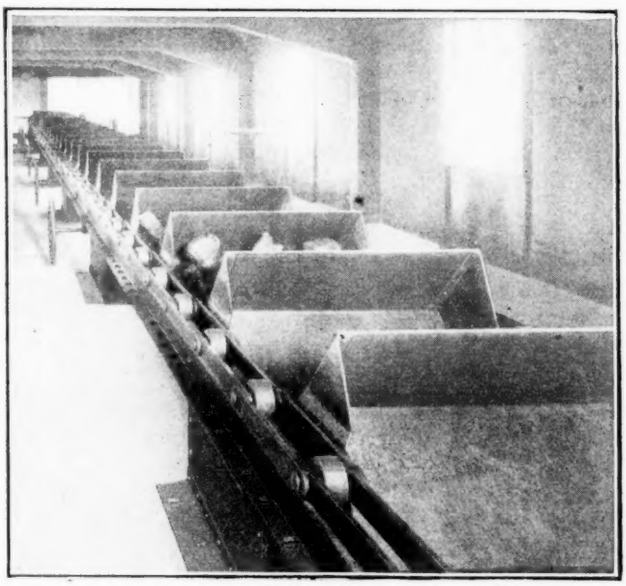


Fig. 4—Gravity discharge elevator and conveyor

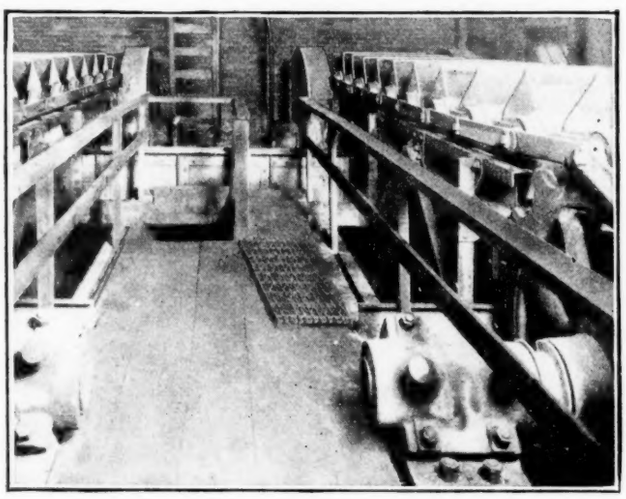


Fig. 5—Upper runs of gravity discharge conveyors at Cahokia

it through gates or openings to an overhead bunker, storage or other conveyor, as conditions require.

Frequently, the coal is discharged or withdrawn from the bunkers or storage into the lower horizontal run of the conveyor, pushed along and picked up by the buckets as their travel changes from horizontal to the vertical direction, then elevated, diverted and again shoved along the upper horizontal run for distribution to desired points.

An advantage of this type of equipment is that the material can be carried at any inclination, varying from horizontal to vertical, as the buckets will carry and

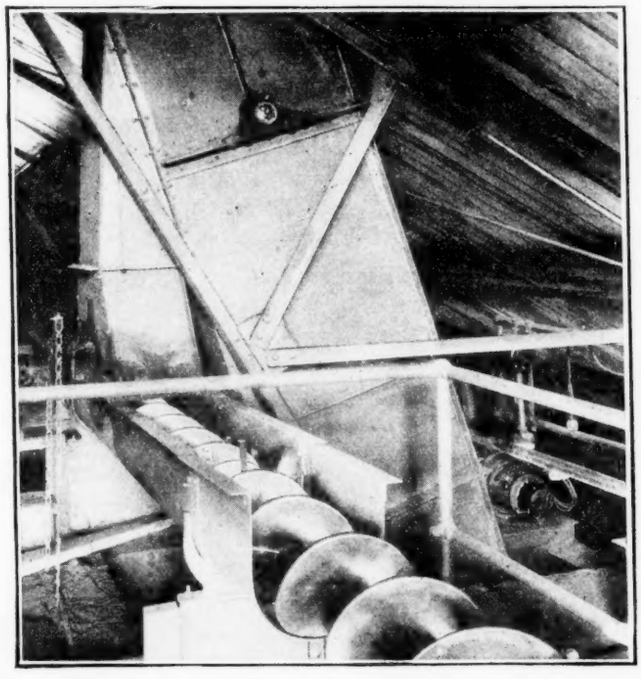


Fig. 6—Screw conveyors receiving coal from centrifugal discharge elevator

convey the material at angles not suitable for flight or belt conveyors.

Usually, the buckets are spaced from 18 to 48 in. apart and vary in size from 12 in. wide by 12 in. long to 24 in. wide by 48 in. long, having capacities ranging from 10 to 400 tons an hour. Malleable chains are used for the smaller sizes of buckets and heavy steel chains for larger capacity installations.

This type is not adapted for handling ash or abrasive materials which cause rapid wear on the steel trough linings, but is admirably suited for many conditions where it can be advantageously used because of its reliable operation and the flexibility of application. Fig. 5 shows the upper discharge runs of an installation at the Cahokia power plant.

Screw conveyors are employed frequently for moving materials horizontally or at slight inclines not exceeding 10 deg. Spiral flights are made from a single steel strip or sections riveted together, which are mounted on a central pipe or shaft.

Usually, the screws are assembled in a steel trough which carries the bearings and hangers and in which the material is pushed along by the revolving flights. The trough is equipped with gates or openings at points where the material is to be discharged.

Screws of from 6 to 24 in. diameter are used, having capacities of from 5 to 125 tons an hour. Their application is principally for handling the small sizes of coal. They are not suitable for conveying ash and other abrasive materials, except when the spirals and trough are constructed of cast iron or manganese steel. The screw conveyor is well adapted for conveying powdered coal. An advantage is the small amount of room required, permitting installations in many places where there is not sufficient space to install other types of conveyor. Fig. 6 shows a centrifugal discharge elevator dumping into a screw conveyor for distribution to overhead bunkers.

Pretreating Boiler Feed-Water with Caustic Soda

By Earl Armacost

Having had considerable experience with different methods of treating feed water in a section of the country where the water is very hard, I should like to pass my experience on to others that are not fortunate enough to have water-softening plants. As most plants have a supply or storage tank of some kind, it is a handy place to use chemicals for treating the boiler water. It is common practice to dump in a charge of chemicals at regular intervals of from four to six hours apart. This method, however, is not satisfactory, as the water is not uniformly treated. To remedy this a simple method was used.

The plant in question uses a tank of 2,000 gal. capacity fed through a 1-in. pipe controlled by a float valve. For feeding the chemicals a 3-gal. can was fastened inside the tank and close to the inlet a tee was put in the 1-in. line and reduced down to ¾-in. and piped to the can, the flow of water to the can being controlled by a ¾-in. glove valve. As caustic soda and soda ash are used, it takes approximately 170 gal. of water to dissolve enough chemicals to treat 1,000 gal. of our boiler water. The exhaust steam from the boiler-feed pumps is also piped into this tank and that keeps the water circulating, and also raises the temperature slightly, but never so much that the steam does not all condense in the tank. A tank used for this purpose must be cleaned at intervals, and for this reason it should be piped to the sewer to permit washing it out with a hose.

Our practice for testing the water for hardness is to take a ½-pint bottle half-full of water and add one teaspoonful of liquid soap. If, after shaking it, the suds last for five minutes, we consider the water soft enough for boiler feed. If two tanks can be used, a better system still is to treat one tank at a time, allowing one hour to soften the water and two hours for the impurities to settle, then alternate from one tank to the other. The piping can be arranged so that changing from one to the other is a simple matter. We also use a quart of sodium aluminate to every thousand gallons of raw water to settle the sludge.

Cylinder heads on Diesel engines have been retained in service even when known to be cracked, but special care must be taken when starting up if the engine has been shut down for some time, as water may have found its way into the cylinder. The safest procedure is to open the indicator cocks and turn the engine a few revolutions before starting.

How To Lay Out Power-Plant Piping—V*

By SABIN CROCKER
Designing Engineer, Drafting and Surveying Bureau, The Detroit Edison Company

WHAT are expansion stresses? How are they handled by the piping designer? The author calls attention to some of the difficulties and uncertainties to be avoided.

The problem is complex, and this article is confined to pointing out the more important sign-posts and pitfalls.

IF A 10-in. steam line 100 ft. long is heated 200 deg. F., it will expand about 1½ in. Now suppose that a jack is used to squeeze this pipe back to its original length, while the temperature is maintained at the high level. This will set up a stress of about 40,000 lb. per sq.in., and since a 10-in. pipe happens to have a metal cross-section of about 10 sq.in., the total push on the ends of the pipe will be some 400,000 lb., or 200 tons, if the pipe does not bend or buckle.

This simple example illustrates the importance of careful study of expansion and stress in steam piping. In an actual installation, of course, a given run of pipe is never held to a fixed length—at least not with success, for if the attempt be made, something is likely to slip or break. Neither is any piece of pipe entirely free to come and go without restraint. And so the calculation of expansion stresses and the design of flexible piping layouts becomes one of the most difficult problems.

It is common practice for the manufacturer of equipment to restrict the permissible thrust against the connecting flange on his turbine or other apparatus. Prudence requires the piping designer to provide liberal flexibility in all lines subject to expansion for safety in operation, but this does not mean that excessive flexibility should be provided at the expense of economy in design. High-pressure piping is expensive, and unnecessary loops, bends and offsets may easily increase the piping costs thousands of dollars on a large job.

Expansion Stresses Should Be Calculated

Stresses arising from expansion should be calculated whenever the most convenient layout of the line is not obviously flexible enough, and if necessary, the calculated results should be checked by making up a small-scale model. Such calculations should not consist of merely taking values for simple bends from handbooks and trying to apply them to complicated piping layouts comprising several bends and turns between anchors. The proper method is to make a mathematical analysis in which the flexibility of the several members making up the pipe line is treated in a single calculation.

Uufortunately, this calculation is not a simple matter, especially in the case of an elaborate piping layout, and in such instances, the study can be handled adequately only by a man who is thoroughly conversant with problems of this nature.

Established formulas must be used with discretion. Caution is necessary in selecting numerical values for coefficients and stresses. Incorrect data have been published on both these points.

In a paper by S. S. Sanford and the author[1] certain rational formulas are derived for determining the stresses and thrusts set up incidental to thermal expansion both in pipe bends and in combinations of bends with straight pipe, and test results are given to corroborate the mathematical derivations. The stresses and thrusts as calculated by the formulas given in that paper are as pointed out therein, considerably greater than the values commonly given.

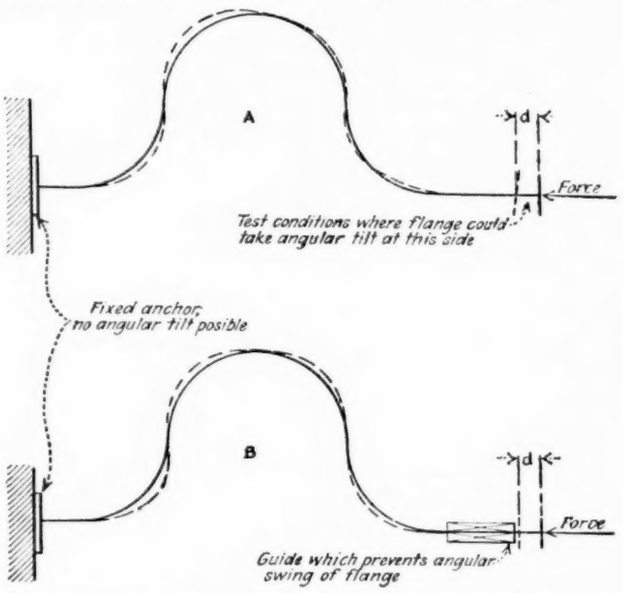


Fig. 1—When the ends of a bend are both held against turning (B), the force is three times what it would be with one end free (A). The stress is increased 50 per cent.

In the calculations given in the paper it was assumed that the flange on one end of a bend was fixed or solidly anchored, while that on the other end was not bolted to anything and hence was free to change its angular relation to the line of action of the expansion force as deflection progressed, as shown in Fig. 1-A. This condition does not exist where both ends of a bend are firmly bolted to the adjacent piping, which is more or less restrained from getting out of line by hangers, sliding anchors, etc., as at *B* in Fig. 1. A further mathematical analysis has demonstrated that for the

*Part I in *Power* for May 18, 1926; Part II, June 8; Part III, June 22; Part IV, July 6.

[1] "The Elasticity of Pipe Bends," by Sabin Crocker and Sterling S. Sanford, A.S.M.E. Transactions, Vol. 44, 1922, p. 547.

same expansion movement the maximum bending stress in an expansion U-bend is 50 per cent greater for the condition shown at *B* than that at *A*, and that the thrust against the anchor is three times as great. As Fig. 1-B represents more nearly than 1-A the condition actually obtaining in most pipe lines, it is evident that even the high values given in the original paper are too small, so that the data widely published in handbooks and catalogs are even farther from the true condition than indicated in the paper. The correction factors given here are illustrations and apply to U-bends only. Factors for other bends have to be mathematically determined for each shape.

The total fiber stress in a pipe wall is the geometrical combination of the longitudinal and transverse stresses due to internal bursting pressure, the bending stresses caused by the dead weight of the piping between supports, and the bending stresses set up by thermal expansion. If the pipe is properly supported the maximum total stress will occur at the point where the bending stress due to thermal expansion is the greatest. With the physical properties at present obtainable in pipe, the total maximum stress at any point should not exceed 10,000 to 15,000 lb. per sq.in. for good design.

Cold Springing

Going back to the illustration in the opening paragraph of this article, suppose that the 100-ft. pipe, while cold, had been stretched $\frac{3}{4}$ in. and bolted in position. This would set up a *tensile* stress in the metal of about 20,000 lb. per sq.in. Then, as the pipe is warmed and expanded, this stress will gradually grow smaller, reaching zero when the pipe has been heated 100 deg. F. Further heating will set up an increasing *compressive* stress, reaching 20,000 lb. per sq.in. when the pipe has been heated through the second hundred degrees. This final stress is only half that set up when the pipe was cut to full length when cold.

The practice of cutting pipe too short, and pulling up joints—known as cold springing—is an attempt to relieve expansion stresses when the piping system is hot. However, it is of doubtful value, since experience has shown that after a high-temperature line has been heated and cooled again the cold springing has almost disappeared. This fact can be demonstrated by unbolting a joint and observing whether the flanges tend to separate; the usual experience is that they have to be forced apart. This is probably due to the material taking a permanent set through prolonged exposure to high temperature while under stress. Piping should be designed with a reasonable amount of cold springing to facilitate getting the pieces into place in erection. In the case of a long line with bends in more than one plane, it often happens that the various members are assembled in such a way during erection as to nullify any cold springing which was contemplated in design. This condition is illustrated in Fig. 2, which shows how a slight swivel movement during erection in a joint subject to torsion may completely remove any designed cold spring.

Data on the Coefficient of Expansion

The elongation of a pipe line due to thermal expansion from the cold to the hot condition is the product of the length of the line times the change in temperature times a coefficient of expansion. The coefficient of expansion is the elongation per unit of length per degree increase in temperature. The correctness of published figures should not be taken for granted, as an investigation may show that they are wrong.

The table gives the elongation per hundred feet of pipe for a change in temperature from 77 deg. F. to 689 deg. F. as calculated from coefficients of expansion

TABLE I—LINEAR EXPANSION BASED ON VARIOUS COEFFICIENTS

Material	Linear Exp. In. per 100 Ft. 77 Deg. F. to 689 Deg. F.	Reference	Authority
Steel pipe	6.89	Crane Cat. No. 51, p. 593	None stated
Steel pipe	6.88	Marks Handbook	None stated
Ingot steel	5.49	Marks Handbook	Holborn and Day
Steel	5.31	Smithsonian Physical Tables, 7th Revised Ed. Reprint, p. 218	Holborn and Day
Annealed steel	4.01	Smithsonian Physical Tables, 7th Revised Ed. Reprint, p. 218	Holborn and Day
Steel pipe	5.56	Special Test Trenton Channel plant	The Detroit Edison Co., Research Dept.

obtained from the sources indicated, in comparison with the elongation measured in an actual pipe line.

The test referred to was made on a section of 16-in. seamless tubing 104 ft. long in the Trenton Channel power house. The line, a steam lead to a main turbine,

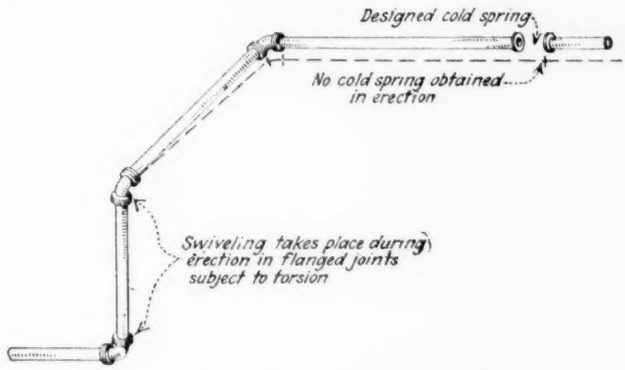

Designed cold spring
No cold spring obtained in erection
Swiveling takes place during erection in flanged joints subject to torsion

Fig. 2—Cold springing is lost if joints are subject to torsion

had been operating for several hours before the final measurements were taken in the hot position, and no further increase in temperature or expansive movement had been observed for some time. Temperatures were read from a thermocouple peened into the outer surface of the pipe wall.

In view of the care taken in bringing the line up to temperature, and the method used in making temperature readings, it does not seem probable that the observed low coefficient of expansion was due to failure in obtaining the correct temperature on which expansion was figured. It would appear rather, to check the coefficient determined by Holborn and Day as given in "Mark's Handbook" as coming the closest, among the references quoted, to meeting expansion conditions, in an actual pipe line.

The difficulty is that the coefficient of expansion is not a constant. It varies with temperature and with the composition and physical state of the metal.

Obviously the result of a single test should not be taken as conclusive, but it does serve to call attention to discrepancies in published figures for expansion coefficients. The use of a coefficient larger than the true one is on the side of safety, but it leads to more expensive installations than necessary, in that larger expansion bends are used to correspond to a greater calculated expansion. In case a large factor of safety is desired it should be obtained by keeping the designed stress low rather than by using a fictitious expansion coefficient.

Many Industrial Power Plants Run Without Instrument Control

Fifty-three per cent weigh their fuel, forty per cent meter the feed water, and twenty-eight per cent meter the steam

THE use of instruments and measuring devices to check performance was an important part of the data obtained from a questionnaire that *Power* sent out to its industrial power plant subscribers.

The answers on this subject are charted here, in terms of per cent, for the four major points of control—fuel, feed, electricity and steam—as shown across the top of the chart. To the right the industrial divisions are indicated, beginning at the top, with a composite summary of all of them in the first line, under the heading "Total."

Thus it is shown that 53 per cent of all the industrial power plants measure their fuel, 40 per cent meter the feed water, 85 per cent meter the electricity and 28 per cent meter the steam.

The very low proportion of performance checks in the lumber and wood industry is due probably to the larger use of waste products for fuel. Similarly, other conditions that affect given industries can be picked out as affecting particular performance control.

The general impression to be obtained as a whole is the striking lack of control apparatus, a condition probably more acute than is actually shown by the chart when the following is understood:

These conditions, while not actually stated, were sufficiently apparent from the nature of many of the returns to have an important bearing.

Measuring fuel in numbers of cases constituted obtaining the railroad weights.

Metering feed was often considered to be accomplished if the incoming water to the plant was metered.

With these points known and their effect on the chart averages estimated, it is apparent that there is a great deal to be done by plant management and by the equipment manufacturers.

There is much talk of economy in operation of power plants. It is evident that the first step is to arrange facilities to check the performances on which economies are waiting to be made.

MEASURE FUEL
METER FEED
METER CURRENT
METER STEAM
53% 40% 85% 28% Total
49 37 93 18 Food
22 30 78 43 Ice
64 31 78 25 Textiles
30 15 53 10 Laundry
58 64 100 27 Iron and Steel
17 22 57 11 Lumber and Wood
60 50 75 30 Leather
50 40 89 70 Rubber
77 69 100 54 Paper
68 64 100 40 Chemical
53 47 76 37 Stone and Clay
100 90 100 40 Metals
76 42 90 24 Machinery
65 35 71 35 Transportation
50 40 100 29 Buildings
25 58 100 25 Mining
52 33 82 28 Miscellaneous Industries

Percentage analysis of check kept on industrial power plant performance

Machinist Mate Waldron Used His Head

AT A recent dinner Commander Ellsberg, U. S. N., related the engineering phases of the salvaging of the submarine "S-51," which sank last summer after a collision with the "City of Rome." The problems encountered in the lifting of this vessel were often new and the solutions engaged the best engineering talents of the country. All the several steps discussed by the Commander were interesting, but none held the attention and carried the moral as did the story of Machinist Mate Waldron.

The submarine was found buried in a bed of clay through which tunnels had to be run in order to pass cables under the boat. Trial was made of using a standard fire nozzle, but the reaction of the jet hurled the diver ten feet or more. Finally, an inch garden hose was substituted and the process of washing out the first tunnel took weeks. The engineering talent of the Navy could suggest no better or faster method. Jetting was the only way and it was obvious that the reaction of a large nozzle was too much for a single diver.

Machinist Mate Waldron knew little of engineering theory, and the law that every action was accompanied by an equal reaction was one he felt could be overcome. So he turned out of brass tubing a nozzle having a standard orifice and also five small ones opening backward. Trial proved the reactions from the five just equalled that of the larger working orifice, and as a consequence a child could hold the nozzle. With this revolutionary device the remainder of the tunnels were dug in a few hours.

The lesson to be drawn is that no matter how lowly be a man's position, he is capable of creative thought. None should allow himself to be persuaded that his ideas are not worth trial, and a superior will find it worth while to give earnest ear to the suggestions of those under him.

The Professor Takes His Own Medicine

HARDLY any salaried professional worker enjoys such freedom of action as the professor. From one end of the year to the other he conducts his courses as he sees fit. No inspector visits his classes to see what kind of a job he is doing.

On the whole this freedom is probably a good thing. It attracts men of initiative and vital force to university faculties in spite of the lure of somewhat higher salaries in industry. It is an outstanding factor in developing that habit of standing on one's own feet which distinguishes the real university from the secondary school.

But academic freedom, like most good things, has its drawbacks. For one thing it has enabled a minority, incompetent as teachers, to hide their deficiencies. Almost every university affords this contrast—one professor holding his class spellbound with interest, while another goes through the forms of teaching before a group of yawning note takers. As often as not, the second man gets as good a salary as the first. Sometimes he gets more in recognition of abilities that shine elsewhere than in the classroom.

But on the whole and "by and large," as they say, the professors are a pretty good lot and show a growing willingness to face honest criticism of their methods. To prove this one need only point to the investigation of engineering education now being made by the Society for the Promotion of Engineering Education with the active co-operation of the faculties concerned. A more sensational proof of the same spirit is furnished by recent developments at the University of Iowa and at Tufts College. In both these institutions criticism of the faculty by the students is actively encouraged. To be specific, each student is asked to fill out a questionnaire telling what he thinks of his various professors, whether he finds their teaching clear and inspiring, etc.

Some will honestly question the advisability of such a procedure, thinking it may give undue advantage to the politically minded professor who would curry favor with the students at the expense of their own best interests. But the professors themselves say it does not work that way. It is reported that the student ratings of the faculty are remarkably accurate. Time will show up the defects of this plan if they exist. Meanwhile Iowa and Tufts deserve credit for willingness to face the light.

Machinery and Instruments

IN THE old days the boiler operator was a busy man. What with wheeling and shoveling coal to keep the pressure up, his energy and time were so fully occupied that such unseen things as CO_2 and air leakage never entered his mind. His was a task of brawn, not brain.

In a modern plant the worthy operator is still a busy man, but in a new way. Machinery has relieved him of the heavy task of handling fuel. Save for siftings and little spills, he need never touch a shovel. His physical labor is reduced to almost zero, but his responsibility is immensely increased, and this is what keeps him busy.

With modern equipment a man controls the burning of ten times the coal that a man could shovel into a furnace, and losses due to faulty conditions are increased in like measure. Hence it is that the advent of machinery into the boiler room has brought with it the ever widening use of instruments whereby the operator has increasingly intimate information concerning what is going on within the furnace. The plant of today makes new demands on the fireman — intellectual

demands. He must understand the process of combustion and heat transfer and devote himself to the control of the machinery that does the hard work.

To the plant owner these developments point the way to reduced cost and a more humane enterprise. The humanity is accomplished with the installation of the labor-saving or labor-aiding machinery, but the reduced cost demands something more, and it is here that many owners fail. The object of the machinery is to eliminate manual labor, but why should that be done except to relieve the man for the higher work of intelligent control? This work requires the information given by adequate instruments. It is good to buy machinery to enable a man to sit in an armchair and think; but it is bad to stop here. Common sense demands the next step —the installation of instruments to give the man in the armchair something to think about, something profitable to the plant whose welfare is his duty.

To the plant operator the growing use of machinery is tremendously significant. It marks his release from hard labor and his rise to better tasks. But so many men welcome the release and never see the opportunity and the challenge that come with it. The man who fails to rise to the possibilities of his job is soon likely to be seeking a job that asks no such effort. Release from toil through machinery is a splendid thing for the individual only when he seizes the new leisure as his means of true salvation through training for greater responsibility.

Performance Guarantees for Regenerative Turbines

LARGE steam turbines that are sold to operate on the regenerative or bleeder cycle, generally have their guarantees made on the basis of operation as straight condensing units with no steam bled. Such guarantees may be necessary owing to the difficulty of securing accurate data when bleeders are in service. When guarantee tests will be run with no steam bled, the manufacturer may be expected to design his turbine to meet the specified steam flow at best load when straight condensing rather than for best load when steam is bled.

Steam may be bled from such turbines in actual operation from one or more points in the casing. If the same load is to be maintained as when under test, this will require increased steam flow through the throttle valve and high-pressure sections of the turbine to provide the bled steam and less steam through the low-pressure blading.

Our turbine designers are steadily increasing their knowledge of the action of blades and nozzles and of the conditions producing maximum efficiency. It is generally recognized that the efficiency is highest in the superheat or high-pressure section of the turbine while leaving losses, high steam velocities and moisture control decrease efficiency in the low-pressure section.

One would therefore naturally expect that a turbine proportioned in all its parts for the proper steam flow when bled as in actual operation, would give a better station performance than one which had been designed to meet test guarantees with no bleeding and in which the pressure distribution and steam velocities will be changed when steam is bled in actual service.

This conclusion is based on certain recognized principles of turbine design and operation. A detailed knowledge of internal efficiencies is necessary in order to determine how great an improvement may be secured by designing a turbine for bleeder performance rather than to use a standard non-bleeding design for use under bleeding conditions. Turbine designers have this detailed information available and should therefore be able to give estimates of this gain. Purchasers are seldom in a position to know the possibilities of the two methods of design and are often unable to secure a true statement of the possibilities of the two methods. It would therefore seem desirable in the interests of the engineering profession that a careful statement comparing the two methods of design and their relative costs should be prepared so that purchasers may have a more complete knowledge of their commercial possibilities.

Getting Acquainted with the Motor and Its Load

TESTING of motors may be more aptly expressed by saying, "getting acquainted with the motors and their loads." This getting acquainted process is essential in the operation of any piece of machinery. The more familiar one is with what is going on in the inner working of a piece of equipment, the better able he is to locate conditions that may lead to trouble and correct them before something happens to put the machine out of service. Or if trouble does develop, knowing the operating conditions makes an intelligent diagnosis of the case more readily accomplished.

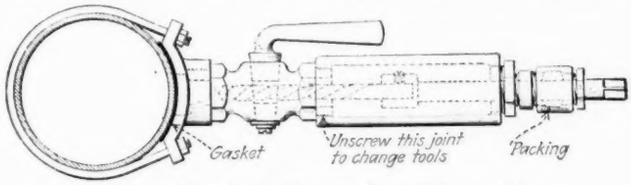
Making tests on motors is frequently considered as applying to the motor alone. However, the driven machine is of equal importance. It is probable that motor tests have shown five times as many defects in driven machines and driving mechanisms as in the motors themselves. One of the advantages of electrical power is that any defects in the operation of a power cycle, from the generator all the way down through the machine driven by the motor, in general, can be detected in the electric circuit. Defects in the driven machine are of equal importance with those in the motor, and in some cases of even greater significance. A defect in the motor will probably not injure anything more than the motor, whereas a defect in the driven machine may injure both the machine and the motor.

There is little that can happen in a motor, if it is kept in good operating condition so far as can be seen by inspection, that will increase its power input when driving a given load, but conditions that can develop in the driven load and connecting drive to change the power consumption are almost without limit. Many of these troubles are not apparent from an external inspection. A plunger pump is a good example of this. The pump acts about the same when the valves are tight and all the water taken into the cylinders is delivered through the discharge as when the valves are in such condition that the water is only being churned in the cylinders. A record of power consumption will show the difference. Centrifugal pumps, due to worn thrust bearings or impellers rubbing, may cause large power increases without giving evidence on the outside, other than heating the motor to the danger point. Leaky valves on compressors, improperly meshed gears, effects of large changes in temperature on lubrication used on the driven machine and a myriad of other troubles may go on unnoticed until something happens, unless those in responsible charge have become acquainted with the motors and their load by periodic tests.

Practical Ideas From Practical Men

Drilling and Tapping a Pipe Line Under Pressure

An occasional job of installing a threaded pipe line from a pressure main is required, or it sometimes becomes necessary to repair a main line without taking off the pressure, and for those interested in the process of making a drilled and threaded connection, the method illustrated herewith may be of interest. The main pipe is fitted with a flanged concave base, having a gasket, under the face and secured with a U-bolt. Into this base a large valve cock is screwed and above this a



Assembly of drilling and tapping outfit

large pipe coupling and reducing connection. Pipe fittings above make up a gland for a toolholder which is free to be revolved.

In use the drill is inserted in the toolholder and the cock is opened while the drill is pushed forward and rotated by the usual means. After the cock is closed, a tap replaces the drill and the hole is tapped, finally removing the tap and substituting a piece of pipe, threaded on the entering end and closed with a pipe plug at the opposite end, after which the drill and tapping outfit can be removed over the connecting pipe.

Washington, D. C. G. A. LUERS.

Correcting Polarity of Field Coils on Compound Motors

A compound-wound direct-current motor has two field windings—a shunt winding and a series winding, as

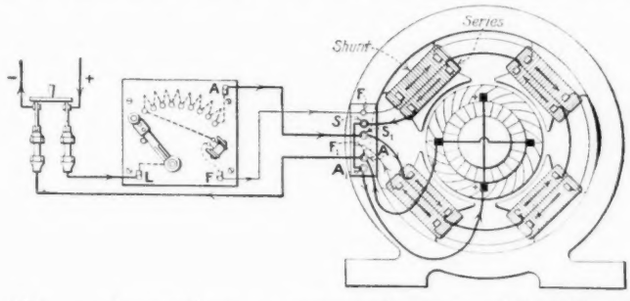


Fig. 1—Connections of compound motor with field coil in opposition

shown in Fig. 1. In most cases these two windings should be connected so that they have the same polarity. If the field windings have opposite polarity, they may produce any one of a number of effects, depending upon the strength of the series field.

Where the series winding has a comparatively large number of turns, as on elevator motors or motors for other applications where high starting torque is required, the motor may fail to start, although making

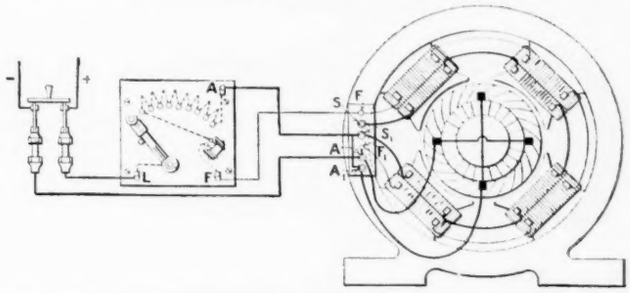


Fig. 2—Connections of compound motor with series winding cut out of circuit

a slight effort to turn first in one direction and then in the other.

The motor may start and, when the resistance is partly cut out, slow down again. If the circuit is heavily fused and the motor is of small capacity, it may reverse and run in the opposite direction at a very high speed and spark badly at the brushes. If the motor is properly protected, the protective device will operate and open the circuit.

The motor may start and operate satisfactorily under light loads, but when a heavy load is applied, it may begin to race and spark badly and cause the fuses or circuit breaker to open.

The latter was the condition once found in the case of a compound motor that was giving trouble. It had

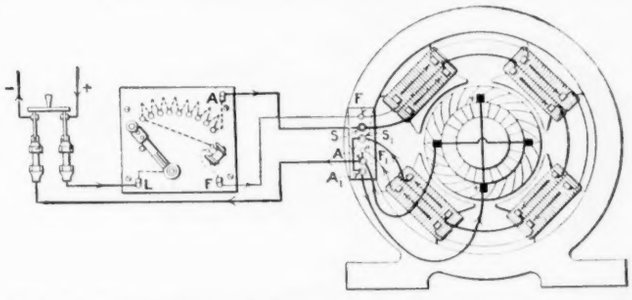


Fig. 3—Connections of compound motor with series- and shunt-field coils the same polarity

been in service for a considerable period, operating partly loaded driving a lineshaft. After adding a new machine to the lineshaft, the motor began to blow the fuses and spark badly at the brushes, at intervals depending upon the class of work performed by the new machine. The motor was connected to a manual-type starting box, and when I was called on to investigate the trouble, the first thing I tested was the polarity of the series- and shunt-field windings.

To make this test the shunt-field winding was dis-

connected at *F* on the starting box. After taking off the belt, an attempt was made to start the machine as a series motor, and it began to revolve in the direction opposite to that in which it had been operating. This showed that the series-field coils were of the wrong polarity. In Fig. 1 arrowheads have been put on the circuits, to show the direction of the current when all circuits are closed to the line, with the original connections. As a check that everything was all right with the shunt winding, the series winding was cut out of circuit, as in Fig. 2, and the motor started as a shunt machine. With this connection the motor came up to full speed in the right direction. The machine was then shut down and the series connections made as in Fig. 3, which shows that the direction of the current in the two field coils is the same.

With the field-coil connections made correctly, complaint was made that the motor ran too slowly. When the field coils were in opposition, the series coils opposed the shunt coils and weakened the field, causing the speed to increase above normal. On connecting the coils properly, the field strength was brought to normal and likewise the speed. There were two ways of getting an increase in speed—one was to change the size of the pulley and the other to cut out the series winding in the motor. The latter was tried and the motor was found to operate satisfactorily as a shunt machine, with connections as in Fig. 2. This did not increase the speed to as high as it was with the field coils in opposition, but it was not deemed necessary to further increase the speed. The speed of the machine operating as a shunt motor could have been further increased by connecting resistance in series with the shunt-field winding, but on this machine this was considered not advisable, as it might have caused the motor to give trouble by sparking at the commutator and brushes.

Cleveland, Ohio. H. R. SAWYER.

Redesign the Ammonia Coils

The greatest trouble experienced by the refrigerating engineer is due to lack of knowledge as to where the ammonia is in the system.

It is regarded as important to keep a liquid seal in the receiver at all times, and we are taught to keep as much in the refrigerating coils as can be kept there without slopping over. But outside of an ice manufacturing plant or a plant with a constant temperature where there is not much fluctuation in load, the average engineer cannot tell within 50 per cent how much liquid and how much saturated vapor is in his refrigerating coils. This is no fault of the man, but is due to the fact that he lacks the necessary equipment to tell him what is going on and why. There are, of course, exceptions to this, due to a man's intuition, but plants are not run by instinct or at least should not be.

This brings one to constructive thoughts. No man would attempt to run his boiler without a gage glass, or a feed-water heater without the same, and, respectively, that is what the evaporating coils and the receiver are. The brine is the fuel that evaporates the ammonia, consequently if one burns more fuel or circulates more brine, more water or ammonia is evaporated. If the feed or expansion valve has the same setting at the same head pressure, the level of ammonia in the coils will drop with a heavy load, making a greater space for vapor and reducing the liquid heating surface, which, in fact, is cutting down the saturated heating surface and increasing the superheating a like amount —an inefficient condition.

To remedy this, I think it would be possible to take a hint from the boiler constructors, who have advanced more in the last 5 years than they did in the 20 before. Make the coils on the order of a modern water-tube boiler with welded headers and parallel tubes or pipes with a drum and with a separator, or dry pipe. Keep the liquid in the coils where it belongs, not on the compressor rods to waste and to reduce volumetric efficiency. Accumulators should be eliminated; it is hard to evaporate in them unless one has real warm liquid.

Such a design would give a good circulation of ammonia; the vapor could get to the vapor or steam space quickly and allow liquid to take its place. This in turn would give a higher capacity than is possible with our series coils in which the ammonia must run 50 or 100 ft. after it has picked up enough heat units to vaporize it.

With good agitation of brine, good circulation of ammonia and a glass or telltale on the evaporating coils, refrigerating would be simplified, and simplicity is success.

I would appreciate criticism on this suggested design.

Baltimore, Md. C. E. ROUZEE.

Removing the Bag from the Boiler Sheet

While visiting a small plant in the country some time ago, I noticed a mechanic endeavoring to push back into place a good-sized bag in the fire sheet of a horizontal return-tubular boiler.

He had a bright red heat on the bulged area of the plate and was driving it back by hammering it at the center where the plate was the hottest. The result was that, when he did finally get it back in place, it was far from its original curvature.

The usual causes for a boiler bagging are carelessness and neglect in not keeping the boiler free from scale and oil. When a boiler plate does become bulged or bagged, it should be given immediate attention. The boiler should be promptly cut out and cooled and repairs made. In my opinion a boiler should never be used after a bag appears in the sheet.

If the bag is caused by oil being inside of the boiler, it is likely to be shallow and covering a greater area than one caused by scale or mud. The shallow bag can be heated and driven back in place with little trouble, but where the bag is deep the plate may have become thin through stretching. When the metal at the apex of the bag gives evidence of having been considerably drawn out, the bagged section of the sheet should be removed entirely and a patch applied. In either case the work should be done by a skilled workman.

The proper way to drive a bag back is first to drill a small hole in the center of it, build up a fire pot with a bellows blast attached and bring the bagged part to a red heat; the plate must be braced inside of the boiler over the bag, with a properly formed section. When the plate is hot, it should be quickly driven back in place with a well-balanced hammer, starting at outside edge of the bulge and working toward the center. In this manner the fiber of the plate will be driven toward the hole in the plate, and this will permit the plate to come back to its original thickness. When the work is finished, the hole can be plugged.

Detroit, Mich. DOUGLAS E. BISHOP.

Comments from Readers

Bubbles in Gage Glass on Ammonia Receiver

Several proofs arrived at in various ways cause me to contend that bubbles rising in the gage glass on a liquid ammonia receiver may not be air bubbles, as stated in *Power*, June 29.

In an ammonia refrigerating test plant now in operation this same bubbling action in the glass occurs. The system is completely equipped with thermocouples for measuring the temperatures of brine, cooling water and ammonia throughout the entire cycle. If air is present in any part of the system, it is immediately noticed by a depressed ammonia temperature; that is, the temperature recorded corresponds to the partial pressure of the ammonia according to Dalton's law of partial pressures. With this scheme the system can be properly purged until there is a surety of no air or non-condensible gases being present, and yet there is bubbling in the gage glass.

It is conceded that air is insoluble in ammonia, yet merely wrapping a piece of wetted waste around the lower end of the gage glass will cause the bubbling to cease immediately. Obviously, the bubbles are not air.

Very often the temperature of the atmosphere in the room is higher than the ammonia liquefaction temperature corresponding to the condenser pressure. A slight difference in temperature will cause heat to flow from the atmosphere to the ammonia, with the result that the ammonia boils. When this flow of heat is arrested by applying cold wetted waste, as explained, the boiling ceases. An electric-light bulb or steam pipe within several feet of the gage glass will cause the same boiling action.

R. E. GOULD, Research Assistant,
Urbana, Ill. University of Illinois.

Sixty per Cent of Engineering Students Drop Out

Some interesting suggestions are made in the letter by E. Ogur in the March 16 issue on "Sixty per Cent of Engineering Students Drop Out." It is believed that the questionnaire which he proposes would give, perhaps not exactly erroneous information, but far from complete and satisfactory results. The object of the investigation must be primarily to obtain information that will serve to aid in safeguarding and raising, if possible, the standard of the engineering profession.

It seems that reports are indicative of a high percentage of engineering graduates being unsuccessful or discouraged with the difficult and competitive outlook ahead of them. The percentage of those who have not the courage to believe themselves above the rank and file is kept high by the ever-present evidence that only the few of exceptional ability really make a success of engineering. Many rise apparently by special opportunities, but I believe that generally means the same thing, for the man of exceptional ability will create the special opportunity. The men of average ability struggle hard and stand by the profession because they like it and will not back out.

Too many engineers design and plan important work while receiving less compensation than the journeymen working by the day in the gangs possibly under their supervision. I believe the questionaire would reveal many of these same journeymen mechanics to be some of the engineering graduates who have dropped from the list of engineers, but who are nevertheless an active part of the engineering organization.

The question of parentage has one important bearing on this subject, namely: The factor of financial assistance at the time of graduation or shortly after. A young man, son of working people, with ambition, zeal and courage, chooses engineering as the means of success. With limited funds he works his way through and gets to be a graduate engineer. He is still zealous and by now loves and believes in the profession. He is offered a position with a manufacturing company which absorbs hundreds of graduates every year.

If he takes this position, he sees hope of being, in the future, a successful engineer with several years' experience with such a company to back him up. And yet by this time he knows the percentage of real successes among those in the employ of the large company is small. On top of that he is confronted with the beginner's compensation which is often less than the actual cost of living in a big city. If he had money, he would accept at once and in a few years would either rise to be a promising engineer or simply remain one of the countless college men who are employees of the company. He has therefore the problem of obtaining additional means of supporting himself until such time as he gained experience enough and is capable of demanding a reasonable salary as an engineer.

On the other hand, if he is naturally a mechanic, he sees chances all around him to enter on jobs as a mechanic, and with his technical training he feels he can make good. The wages are high, therefore he sees his way to get a good start financially, and then after that he can swing back to the engineering line and work up his experience with some big company. This idea, which I believe many entertain, seldom materializes.

What can be done or what needs to be done to lessen the percentage of engineers dropping from the list I do not venture to state. The various branches of engineering are doubtless greatly benefited by the withdrawal of so many candidates. While there may be an abundance of engineers in the field, there will always be a demand for engineers of ability. There is no question that the large manufacturing companies along some lines at least find it profitable to employ graduates at low wages for a few years. I have often wondered how many promising engineering careers are ruined by the unsatisfactory conditions they meet immediately after leaving college or are diverted to other means of obtaining a livelihood.

R. G. FISHER.
U. S. Naval Station, Cavite, P. I.

Write Yourself to the Fore

I have read with interest the various comments that have appeared on the editorial "Write Yourself to the Fore" and especially the letter of Charles E. Colburn in the May 25 issue. I agree with Mr. Colburn that there is a tendency of many engineers to try to write themselves to the fore when they have nothing to say that is of importance to the craft, but I think that when a man has made some improvement in his plant, some new way of getting better results, he should pass it on and I see no attempt of self advertising in his doing so.

As to the employers objecting to this, I can only say that during my 30 years' experience I have never had an employer object to my passing anything of value along, or telling through the press or any other way of any improvement that we had made. Probably I have been more fortunate in this respect than others, but all the men that I have worked for felt that if we could save an extra pound of fuel, it was good business to let the other fellow know how we did it.

Since I have been in my present position as chief of the plant here, we have made several improvements that have cut the cost of operation a great deal. Some of these were "home-made," others purchased, and our master mechanic takes pride in bringing visitors in and showing them what has been done. There is no desire on the part of my employers to "hide our light under a bushel," and they are only too willing that we pass along a good idea.

THOMAS M. STREET.

Wilkesbarre, Pa.

Boiler Furnace Dry Gas Losses

The conventional method for testing stationary steam boilers prescribed by the American Society of Mechanical Engineers when followed, according to Data and Results of Steam Boiler Test, Table S1a, Heat Balance of Steam Boiler, Table S1b, Computation for Test of

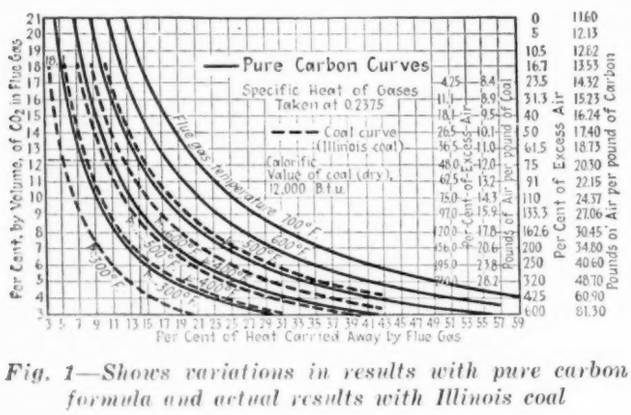

Pure Carbon Curves
Specific Heat of Gases Taken at 0.2375
Coal curve (Illinois coal)
Calorific Value of coal (dry) 12,000 B.t.u.
Per Cent. by Volume, of CO2 in Flue Gas
Per Cent of Heat Carried Away by Flue Gas
Per Cent of Excess Air
Pounds of Air per pound of Coal
Pounds of Air per pound of Carbon

Fig. 1—Shows variations in results with pure carbon formula and actual results with Illinois coal

Steam Boiler, Table S1c, will give sufficiently accurate results for the comparison of boiler performance, although such results will be subject to variations in the heat balance due to the method of computation for fuels that contain hydrogen and sulphur that are not taken into account, although they would be considered with a more elaborate and detailed test code.

The formula for calculating dry gases is based on carbon instead of the dry gases from coal, which will show 2 to 3 per cent higher than the actual loss. It is often seen that when boiler trials are made, burning high-volatile coal, the sum total of the heat balance may exceed 100 per cent by 3 to 5 points.

The Babcock & Wilcox Co., in the book "Steam," pages 167-69, give the formula for computing combustion data from flue-gas analysis and also state the errors that will occur by its use, although it is not sufficiently clear for one to grasp the real significance. The curve,

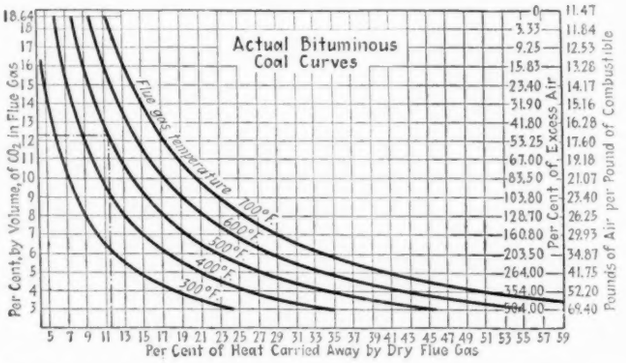

Actual Bituminous Coal Curves
Flue gas temperature 700°F.
600°F.
500°F.
400°F.
300°F.
Per Cent. by Volume, of CO2 in Flue Gas
Per Cent of Heat Carried Away by Dry Flue Gas
Per Cent of Excess Air
Pounds of Air per Pound of Combustible

Fig. 2—Per cent of heat carried away by dry flue gas with bituminous coal

Fig. 1, shows the variation in results due to the pure carbon formula and the actual results from Illinois coal based on the following analysis: Carbon, 60.0 per cent; hydrogen, 5.4; nitrogen, 1.0; oxygen, 18.6; sulphur, 2.0; ash, 13 per cent; heating value, 12,000 B.t.u. per pound. The reactions of the combustion are:

$$\begin{array}{lllll} C & + & O_2 & = & CO_2 \\ 12 & & 32 & & 44 \end{array} \qquad \begin{array}{lllll} S & + & O_2 & = & SO_2 \\ 32 & & 32 & & 64 \end{array}$$

$$\begin{array}{lllll} 2H_2 & + & O_2 & = & 2H_2O \\ 4 & & 32 & & 36 \end{array}$$

The oxygen required for burning one pound coal is:

Oxygen for carbon	0.60	× 32/12 =	1.60 lb.
Oxygen for hydrogen	0.054	× 32/4 =	0.432 lb.
Oxygen for sulphur	0.02	× 32/32 =	0.02 lb.
Total oxygen required			2.052 lb.
Oxygen from coal			0.186 lb.
Total oxygen to be supplied			1.866 lb.
Nitrogen accompanying			6.22 lb.
Air necessary			8.086 lb.

Volume of air at standard conditions $\frac{8.086 \times 16}{1.293} = 100$ cu.ft. air

Weight of CO_2 formed is	0.60	+ 1.60	= 2.20	lb.
Weight of H_2O formed is	0.054	+ 0.432	= 0.472	lb.
Weight of SO_2 formed is	0.02	+ 0.02	= 0.04	lb.
Weight of N_2 formed is	6.22	+ 0.1	= 6.32	lb.
Total weight of gases				9.032 lb.

Weight of dry gases 2.20 × 6.32 = 8.52 lb.

Volume CO_2 2.20 × $\frac{16}{1.98}$ = 17.77 cu.ft. 18.1 per cent CO_2

N_2 6.323 × $\frac{16}{1.26}$ = 80.29 cu.ft. 81.9 per cent N_2

98.06 cu.ft.

From the calculated data we can now construct the actual coal curves. It should be noticed that the specific heat of gases has been taken at 0.2375; the reason for this is that the carbon curve is already computed on this basis. The specific heat now accepted by the A.S.M.E. is 0.24, thus when the losses have been determined, they should be increased $\frac{0.24}{0.2375} = 1.01$ times, although this is a refinement not warranted in this case. To make more clear the difference between the A.S.M.E.

code short form, it would be well to take for example the tests made at Oneida Street station.

The coals burned were 50 per cent Youghiogheny and 50 per cent Pittsburgh, and the results show the flue-gas temperatures to be 496.6 deg. F., CO_2 12.26 per cent and the loss due to heat carried away by gases 11.93 per cent. Referring to the curve, Fig. 2, this loss is shown by the dot-and-dash line, which follows the 12.26 per cent CO_2 line across to the right to 496 deg. F. temperature curve, then down to the base line showing 11.5 per cent loss, thus checking the test data that are theoretically correct. The conventional A.S.M.E. short form was not followed, however, and if it had been and the pure carbon curve No. 1 used, these losses would have been 14 per cent.

The heat balance 100 per cent would then be exceeded, the sum total being 102½ per cent, a condition that has shown up recently in results where high-volatile coal was burned.

J. GOULD COUTANT.

New York City.

To College Seniors

The editorial headed "To College Seniors" in the April 20 issue, is timely, and points the way for a college graduate toward a real field of usefulness; but I feel that it was altogether too brief for a subject so important to the young man who may be casting about for a career in which he can see a profitable future.

More than pointing out that modern power plants are cleaner places to work in than was formerly the case, is needed to induce a college graduate to enter the operating field. He has to be shown that in due time his efforts, plus his education, will pay dividends that will adequately compensate him for some of the early hardships.

It is true that the testing departments offer opportunities, at times, that appeal to young engineers, but my observation leads to the belief that as stepping stones to financial or engineering advancement they leave a lot to be desired.

The other departments offer more of a future to the man who is willing to make certain sacrifices for the required period of time, but those sacrifices are particularly hard for the college graduate to make, for he has usually become accustomed to a certain social standing and its activities. That standing immediately becomes zero and remains so until he rises to the heights of a desk job, or better still, has his name on the office door. He will be forced to work for and with men that will amaze him if he tries to analyze their methods in the light of what he learns at college. He will work long hours for small pay; there will be few leaves of absence to attend college gatherings; and, if he attains any responsibility, except in a large plant, he will probably spend most of his spare time in looking out for his own welfare by overhauling some part of the equipment that needs repairs.

But notwithstanding the drawbacks, there are real opportunities in power-plant operation, as I see it, for the college graduate, and following are my ideas relative to how he should approach the field to attain a desirable future.

First, he should secure a job in the fire-room, preferably in a small plant, and serve the time necessary to secure such licenses as are required by the state. By doing as he is told and being associated with Pat, Pierre, Tony, Mose, etc., he will soon acquire all the practical knowledge he needs, at the same time learning something about the characteristics of firemen's labor, and their viewpoints on life, that will be extremely valuable later on.

One thing he must do, at this stage or any that comes later is to keep to himself, within reason, the fact that he has a college education. His chief will know it and make use of it as he requires it, but so far as others are concerned let them find it out for themselves. While most of the men he would work with are the "salt of the earth," so far as being men are concerned, they will be less fortunate along educational lines, suspicious of his motives in working with them, and will always be looking for a chance to show him up, if they get the idea that the graduate feels in any way superior to them. If he is accepted as one of them, conditions will be much better and he will get many a hint that will smooth out the rough spots in the day's work.

The next step should be to secure a job in the prime-mover section of some plant and start on the road to an engineer's license; first-class. Along with his other activities the young man should endeavor to secure a working knowledge of machine shop practice, pipe fitting and the installation of mechanical and electrical equipment.

The program outlined may seem to be a long and hard one, and in some ways it is, but it must be remembered that the graduate, by his education, is several years ahead of the usual candidate for licenses and the actual service time required by law is not excessive. Once the final license is obtained, the graduate is in a position to sell his services to the greatest advantage.

He is prepared to assume the position of operating, combustion, test, designing or sales engineer, with more than a reasonable hope of success, since he is prepared to meet both technical and practical men on their own grounds, with equal confidence. It needs no great amount of thought to determine what an asset that will be.

It seems needless to say that the program must be intelligently planned and carried out to be successful. The young man must not be afraid of work or dirt and must be willing to change, not only preconceived ideas but employers, so that when, for instance, he has mastered the firing of one type of boiler, he will look for a chance to fire other types. The same applies to steam engines and turbines. He is not after a life job in any one plant, but rather, a varied experience that will fit him for higher positions.

It is assumed that the young man would take a reasonable interest in the activities of the local engineering societies, if any, and lose no opportunities to make acquaintances in all phases of business. Because of his education he should, in due time, be able to write or speak convincingly on subjects connected with the profession, and thus make himself better known against the day when he will be looking for a position where he can cash in on his apprenticeship.

The foregoing is merely what I believe, based on observations and experience, I should do if I were graduated from a college at the present time, and I hope that others may find it convenient to contribute their views on the subject.

C. M. DURGIN.

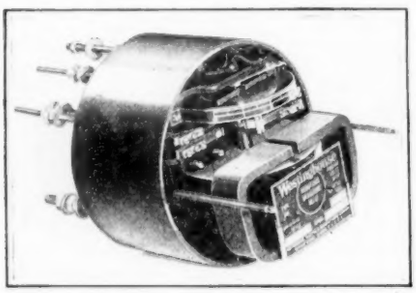
Edgewood, R. I.

New and Improved Equipment

New Line of Direct-Current Relays

A new line of direct-current relays has been developed by the Westinghouse Electric & Manufacturing Co., which include resistance measuring, over-current, voltage, polarized and other types of relays, closely resemble this company's induction-type alternating-current line, and occupy about the same amount of switchboard space.

These relays operate on the magnetic-vane principle and are constructed so that their operating values of current or voltage and their time of operation may be determined with a high degree of accuracy. They possess adjustable features so that the quantity operating them is adjustable, as well as their operating time. A new form of contact made of chemically pure silver is used, which is easily aligned or removed in entirety for cleaning by the use of a screwdriver.



Relay for use with service-restoring circuit-breaker

The resistance-measuring relay has been developed for automatic service-restoring circuit-breakers and actually measures the resistance of the feeder. It recloses the breaker when indications are that the short-circuit has cleared. A particular feature of the resistance relay is its time limit, which prevents the breaker from pumping rapidly when the trouble is of a recurring nature.

Hall-Will Portable Electric Pipe Machine

The portable pipe machine shown in the accompanying illustrations is a recent development of Hall-Will, Inc., Erie, Pa. The machine is designed for threading pipe in sizes from ¼- to 2-in. and bolts from ½- to 1½-in. It can also be used as a power unit for driving hand stocks up to 12-in. by the use of a universal shaft.

The machine is essentially a portable unit, but can be changed over readily to a stationary one. The rear feet of the machine are mounted on small wheels, while the front feet are provided with double swivel castors which elevate the front of the machine when the handle is moved forward.

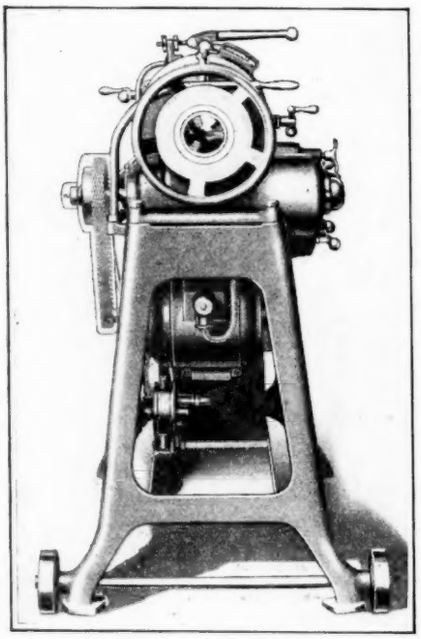


Fig. 1—End view of machine showing arrangement of drive and controls

The machine is driven through a silent chain direct from a 1-hp. reversible motor bolted to the main frame. A friction clutch operated by a lever handle on the top of the machine is provided for the starting and stopping of the machine. Three speeds are provided, these being changed through selective slide system with a neutral position between shafts.

The opening and closing of the die head is accomplished through a lever handle conveniently located at the top of the die head. Close nipples can be threaded without extra equipment, the standard chuck on the machine being adaptable for this work. Adjustments can also be made for oversize and undersize threads.

The cutting oil and chips return to a drip pan at the front of the machine, and the oil drains off to an oil reservoir below. The oil is supplied to the cutting tool and die head by a rotary geared pump driven directly from the motor.

Four sets of chasers to cover complete range of the machine, one set of cutting off tools and an extra set of dies in sizes from ¼- to 2-in. are standard equipment with the machine.

Marley Spray Pond Fittings and Nozzle

For several years the Power Plant Equipment Company, of Kansas City, Mo., has been a manufacturer of special castings and fittings required for spray-pond work, such as group tees of straight and reducing patterns.

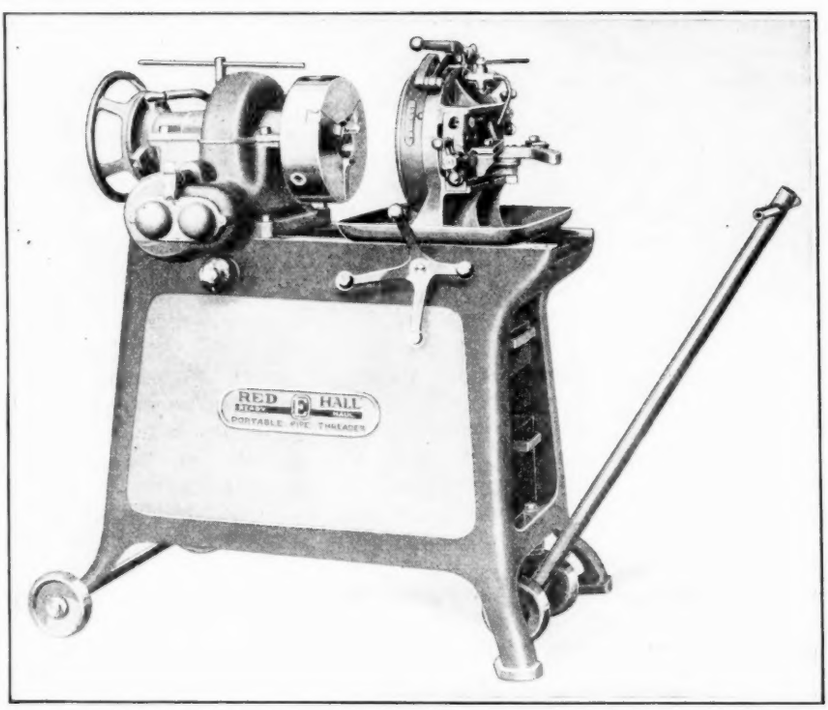


Fig. 2—Machine is readily convertible for portable or stationary use

Quite recently, the Marley spray nozzle has been developed. Unusual features of the design are the large rectangular venturi-shaped inlet orifice and the upper bottle-like whirl

Fig. 1—Venturi-shaped inlet orifice

chamber. The free sectional area throughout is large. The water enters from the side through a converging venturi-shaped throat, which tends to minimize eddy current and pressure losses. Owing to the location of the

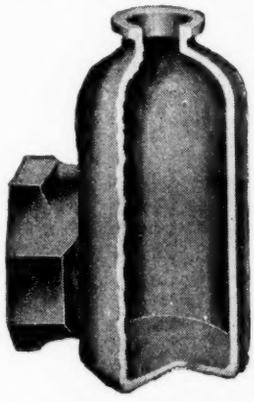


Fig. 2—Section of whirl chamber

inlet orifice, the incoming water is admitted at maximum velocity, imparting a strong whirling motion which is accentuated by the whirl chamber. The discharge is through a comparatively large orifice.

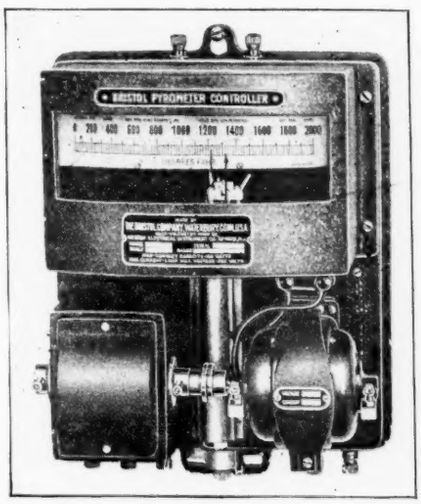
With large free openings all the way through and no projections or deflectors to interfere, clogging of the nozzles is practically eliminated. It is claimed that the nozzles will pass freely any solid that will work its way through a surface condenser. The nozzle is made for all the standard pipe sizes used and for a wide range of pressure.

Bristol Temperature Controller

The Bristol Company, Waterbury, Conn., has recently added to its line of temperature-control equipment the pyrometer controller model No. 479 shown in the illustration.

The controller is fitted with an extra wide scale motor drive and external contractor adjustment, and the working parts have been made readily accessible for adjustment and oiling. A governor is provided to regulate the speed of the driving motor, which is connected to the driving shaft through a non-metallic coupling.

A feature of the instrument is the safety adjusting mechanism for setting the position of the index at the point to which it is decided to bring the temperature. A small hinged cover is used to inclose the adjusting knob. This knob cannot be operated until the cover is opened, and the act of opening the cover automatically forces the switch mechanism to its lowest position, free from the pointer. With this pro-



Temperature Controller, Model 479

vision there is no possibility for the operator to damage the millivoltmeter movement.

The controller is designed for use with oil, gas or electrically heated equipment such as ovens, furnaces, etc. and can be used on all temperatures up to 3,000 deg. F.

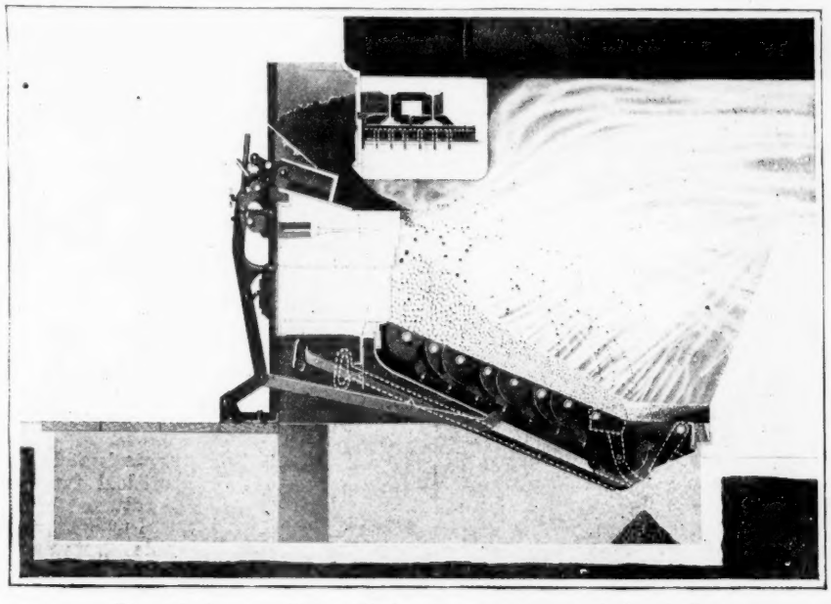
The "Pulverzone"

Burning the fines in suspension and spreading the larger particles of coal according to their weight over the entire grate area is the method of combustion followed in the "Pulverzone," a new type of coal-burning equipment recently developed by the CoKal Stoker Corporation, Wrigley Building, Chicago, Ill.

In reality, the "Pulverzone" is an improved CoKal power-feed stoker with the added feature of a controlled air blast across the furnace front over the fire, which not only spreads the coal, but produces a turbulence before, at and after ignition, with the object of intimately mixing the air and the volatile.

The accompanying sectional elevation of the stoker shows the principle of operation. Immediately beneath the ledge over which the coal feeds into the furnace a series of steam or air nozzles that supply the blast are installed. There are eight of these nozzles, paired V-shaped, consisting of ¾-in. pipe flattened at the end to give a narrow, rounding slot from which steam or air will flare out and in combination with the other jets give a uniform blast across the width of the furnace. The pressure used varies with the character of the coal and the quantity being fed. The operating range will vary from 5 to 30 lb., the latter pressure being required at the highest ratings. It is claimed that less than 2 per cent of the rated boiler capacity is required to produce turbulence, feed the coal and operate the entire mechanism.

Passing through the falling curtain of coal, the blast carries the fines, comprising 60 per cent of ¾-in. screenings, into the furnace space, where they ignite in suspension. The coal particles are distributed over the fuel bed according to their weight, the coarser coal dropping down directly in the coking zone at the front, while the lighter pieces pass toward the rear. Segregating the coal in this way, so that like sizes fall into the same zone after the removal of the fines, gives a porous fuel bed that offers low resistance to the air supply, so that intensive combustion with minimum draft is possible. Ratings up to 350 per cent have been obtained.



The "Pulverzone" installed under a return-tubular boiler

Diphenyl-Oxide Bi-Fluid Power Plants

Compound Said To Be Superior to Mercury for Use in Binary-Vapor Power Systems

A NOTEWORTHY feature of recent developments in the power field is the increasing co-operation of experts in related scientific fields. Metallurgists, physicists and chemists are playing an active part in the campaign for increased efficiency and lower cost of power generation.

Co-operative work of this sort was exemplified by the paper which H. H. Dow, president of the Dow Chemical Company, presented at the A.S.M.E. session of the annual meeting of the Association of Chemical Equipment Manufacturers recently held in Cleveland. In this paper Mr. Dow proposed the use of diphenyl oxide instead of mercury as the high-temperature fluid in binary vapor power plants.

Diphenyl oxide had already been considered and rejected in favor of mercury by W. L. Emmet, who constructed the much discussed mercury-steam plant at Hartford, Conn. Mr. Emmet's reason for rejecting diphenyl oxide was its supposed tendency to decompose at the temperatures carried in the primary vapor boiler. Mr. Dow claimed that with proper boiler design the

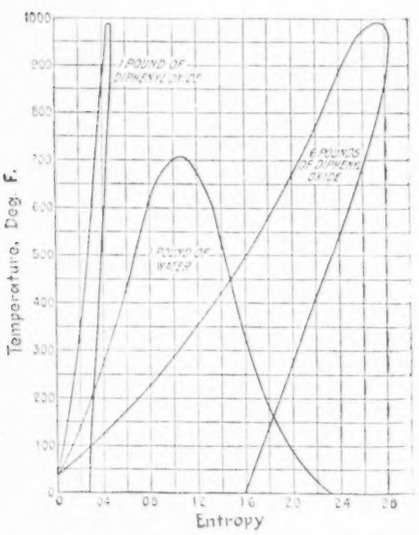


Fig. 1—Temperature-entropy diagram for water and diphenyl oxide

amount of this decomposition is practically insignificant.

The following is quoted from his paper as reported in the August issue of *Mechanical Engineering:*

Mercury has properties that are superior in many respects to those of any other substance. It is capable of being raised to a higher temperature than any other known liquid. Any organic material has a limit beyond which it will decompose, whereas there is no temperature at which mercury will not be mercury. Accordingly, it has an unlimited field, if a material can be found that will hold and use it at extreme temperatures. This was clearly understood by the man who developed the bi-fluid system, Dr. Emmet. However, he failed to recognize the availability of the organic compound, which, so far as the author knows, has the highest boiling point with the greatest practicability, namely, diphenyl oxide. On the contrary, Dr. Emmet states that it would decompose in a boiler. Now, the author's company happens to be the only manufacturer in the United States that makes diphenyl oxide on a large scale, and in its process of manufacture it employs a higher temperature than

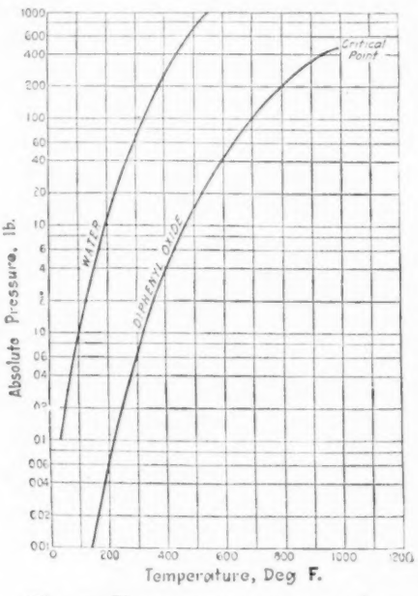


Fig. 2—Vapor-pressure curves for water and diphenyl oxide

that at which Dr. Emmet thought it would decompose.

Accordingly, some of this diphenyl oxide was purified at various temperatures and it was found that it did not decompose under the proposed conditions.

Diphenyl oxide is a white solid at room temperature, but a liquid if it contains a slight amount of impurity. It melts at 81 deg. F. when very pure. The fact that it is a solid is a slight objection, but any part of the boiler room where it would be used would have a temperature above 81 deg. Its specific gravity is 1.083 and its boiling point at atmospheric pressure is 496 deg. F., which is the temperature of saturated steam at 680 lb. pressure.

At 200 lb. pressure its boiling point is 800 deg. F. Its specific heat is approximately 0.4. Its critical pressure is 465 lb. at a temperature of 986 deg. F. Another physical property not often recorded in the tables is its price. In quantity lots it is worth 30 cents a pound. It can be produced in unlimited quantities, and the cost per unit volume is less than 2 per cent of the cost of the same volume of mercury.

One of the thermodynamic properties of diphenyl oxide is that in an ordinary turbine where it expands adiabatically, instead of condensing like water it superheats to a marked degree, even

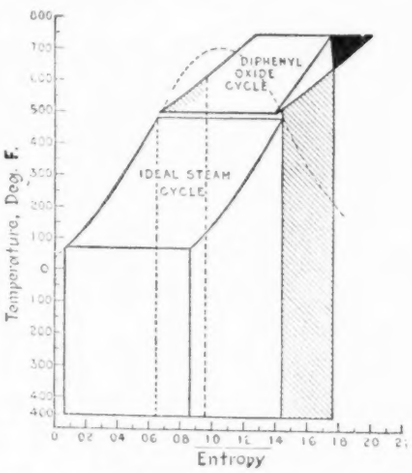


Fig. 3—Temperature-entropy diagram for diphenyl-oxide bi-fluid plant

Diphenyl oxide, 135 lb. to atmosphere; water, 600 lb. to 29½ in. vacuum

in a 100 per cent efficient turbine. For example, when the vapor expands from 135 lb. gage down to atmospheric pressure where the boiling point is 500 deg. F., the temperature, instead of being 500 deg., is about 625 deg.

This extreme amount of superheating has an advantage and a disadvantage. It is difficult to transfer heat from a superheated vapor. Accordingly, when this vapor is exhausted at 625 deg., it is necessary to use it regeneratively to heat the boiler feed in order to get 90 per cent of the Carnot cycle, otherwise the efficiency of this cycle would be only 75 per cent. We have 15 per cent as the goal to be gained by using regenerative heating, that is, taking the exhaust superheat from the turbine and using it for reheating the boiler feed, which corresponds to bleeding in an ordinary steam installation. A certain amount of this can be done, but whether it can be brought up to 90 per cent without prohibitive expense, has not yet been demonstrated.

Another advantage of diphenyl oxide is that the weight of its vapor is about 9.4 times that of steam vapor. This means that a diphenyl-oxide turbine will run at a lower speed with higher torque for the same horsepower than a steam turbine, which is a great advantage. It may be that on that account we shall get a little higher turbine efficiency and we shall certainly get some higher turbine efficiency by reason of the fact that there is never any condensate in the vapor.

One difference between diphenyl oxide and mercury is that the latter does not wet steel, and on this account the boiler tube may get much hotter than the mercury; whereas diphenyl oxide does wet the tube, so that it is easier to transfer the heat from the boiler to the liquid.

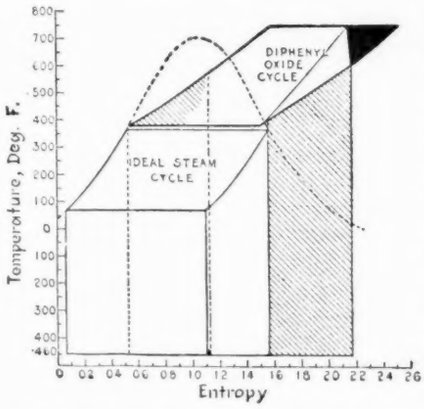


Fig. 4—Temperature-entropy diagram for diphenyl-oxide bi-fluid plant

Diphenyl oxide, 135 lb. to 24 in. vacuum; water, 150 lb. to 29¼ in. vacuum

For these various reasons the author feels very confident in proposing the diphenyl-oxide bi-fluid plant working between 750 and 70 deg. F. The diphenyl-oxide vapor would be generated in a boiler at 135 lb. gage pressure and expanded to a vacuum depending on the steam pressure with which it is desired to work. The temperature-entropy diagrams show two such combinations, one (Fig. 3) in which the diphenyl oxide is condensed at atmospheric pressure, making steam of about 600 lb. pressure, and the other (Fig. 4) exhausting at about 24 in. of vacuum, making steam of 150 lb. pressure.

The black area in each diagram represents the difference between the Rankine and the Carnot cycle in the proposed diphenyl-oxide cycle. The saturated vapor enters the turbine at 750 deg. F. and expands to the exhaust pressure with a temperature considerably higher than the condensing temperature. The superheat in the vapor, represented by the shaded area, is then removed in a counterflow boiler-feed preheater. The heat of vaporization at the condensing temperature is given up to the water in the condenser boiler and the liquid diphenyl oxide is returned to the boiler through the preheater. The steam should be superheated by direct heat or by diphenyl-oxide vapor in order to gain the increase in the efficiency of the turbine.

Specifications for Diesel Lubricating Oils

IN VIEW of the wide variations in lubricating oil consumption and costs, the General Committee of the Diesel Engine Users Association, England, in 1924 considered the matter and decided that efforts should be made to determine the proper limits of consumption of lubricating oil in oil-engine plants. A small subcommittee was thereupon appointed to pursue investigations into the subject.

The subcommittee reported in due course that although such factors as the type of engine, age of liners, etc., matters not always immediately within the control of the operating staff, have a decided influence on the total oil consumptions, it was satisfied that high lubricating costs are frequently due to factors that, with proper guidance, would be capable of control and in particular to the use made of efficient recovery plant and to the purchase of an economical oil.

Scarcely any information is at present generally available concerning the most suitable and economical oil to use in heavy-oil engines, and extremely wide differences occur in the class of oil as well as in the prices charged by the various suppliers. On the face of it such wide differences in practice would appear to be wrong, but the subcommittee did not find it practicable to get tests with different or similar oils carried over long periods under sufficiently similar conditions to justify reliable conclusions.

The General Committee subsequently decided to obtain independent analyses of samples of various oils and to compare these. The analyses, which were made without disclosure of the names of the suppliers, showed, as was expected, widely different characteristics in the oils. The committee then invited Harold Moore, a well-known analytical chemist and authority to put forward specifications embodying characteristics that would insure a first-class engine oil, without including any highly expensive feature, which it would be practicable for the great majority of oil dealers to supply.

Altogether, thirteen samples of lubricating oil, used by members of the association, were analyzed on behalf of the committee. The table shows the extreme limits of difference discovered.

The specifications cover oils that are suitable for all purposes on an oil engine, excepting that for some air compressors it is desirable to use a slightly compounded oil.

It should be noted that the test for specific gravity is of interest by reason of its indication of the origin of an oil. Thus, an oil possessing a density below 0.900 is generally of Pennsylvania origin (paraffin base), and an oil of a density of 0.900 or above is generally of mid-Continental origin (asphalt base). Specific gravity is also an indication of stability in use. The less the density the greater the power of resistance to change and the greater the proportion of oil recoverable. A specific gravity of 0.880 is the lowest commercially obtainable for the purpose of lubrication.

The viscosity temperature curve of an oil bears a close relation to its density. In selecting a lubricating oil, the course of this curve should therefore be studied. Care should be exercised that an oil is reasonably fluid at 70 deg. F. and not too thin at 200 deg. On the other hand, if the viscosity at 200 deg. F. is too high, a reduction in mechanical efficiency will ensue and bearing temperatures will be higher.

In the consideration of flash point the closed test should be adopted. The open test will give results from 20 to 30 deg. F. in excess of those obtained by the closed test. When the closed flash point is low, vaporization increases and there is a definite risk of flashing of oil vapor. This is a matter of much importance in the case of engines having inclosed crankcases.

The color of the oil should be a clear red when examined by transmitted light. An appearance of fluorescence is not a necessary feature of lubricating oils for Deisel engines.

A good lubricating oil should possess a low setting point; that is, it should remain fluid under conditions of low temperature.

The committee stated that the important question of oil recovery has a bearing on the subject of compounded oils, in that oils containing fatty constituents are less readily cleaned than are pure mineral oils.

SPECIFICATIONS FOR LUBRICATING OILS FOR USE ON HEAVY-OIL ENGINES

(Diesel and other high-compression types)

Specific gravity at 60 deg. F	0.880 to 0.934
Closed flash point	375 deg. F. to 450 deg. F.
Viscosity in Saybolt seconds:	
At 70 deg. F.	800 to 2,500
At 100 deg. F.	260 to 750
At 140 deg. F.	120 to 250
At 200 deg. F.	57 to 100
Cold test	15 deg. F. to 40 deg. F.
Saponification value	Nil
Color	Very dark green to a clear red

All samples tested were pure mineral oils.

The committee gave a considerable amount of time and attention to the question and now recommend the following two specifications:

	Specification A. (100 to 240 r.p.m.)		Specification B. (Above 240 r.p.m.)	
Specific gravity at 60 deg. F (water = 1)	Not exceeding..	0.855	Not exceeding..	0.882
Closed flash point, deg. F.	Not below.....	400	Not below.....	400
Viscosity in Saybolt seconds*				
at 70 deg. F.	Not exceeding..	1,375	Not exceeding..	800
at 200 deg. F.	Not less than...	65	Not less than...	57
Cold test of Pour Point, deg. F.	Not higher than	35	Not higher than	35
Color or by transmission light	Clear red.....	.....	Clear red.....	.....

The oil shall be a straight mineral oil.

Method of testing: Inst. Pet. Tech. No tolerances allowed.

*The original tabulations used Redwood Scale, but these have been changed to corresponding Saybolt readings.

News in the Field of Power

J. M. Graves, of Duquesne Light Co., Dies

James M. Graves, vice-president and general manager of the Duquesne Light Co., fell dead July 23 in Grant street while walking to his office in the Philadephia Building, Pittsburgh, Pa.

Apoplexy was first believed to have caused the death of Mr. Graves, but an autopsy later revealed that death was due to angina pectoris. He had just finished an inspection trip of the Pittsburgh Railways Co. and apparently had been in good health while making the trip. Mr. Graves had been planning an extended vacation in Atlantic City as a relief from his strenuous efforts in behalf of the erection of a $40,000,000 power plant at Shippingport to supply electricity to the Beaver Valley.

He was regarded as one of the foremost authorities in electrical power development and had been instrumental in inaugurating many of the practices at the Colfax plant of the Duquesne Light Co.

Mr. Graves was born in Lexington, Ky., in 1878. He graduated from the University of Kentucky, Lexington, in 1900, with the degree of mechanical engineer. After serving a short time with Field & Hinchman, consulting engineers, of Detroit, he moved to Pittsburgh and entered the employ of the Heyl & Patterson Co.

In 1902 he became assistant to W. A. Shoremen, general engineer of the Allegheny Light Co., and later assistant superintendent of power stations, in charge of operation of the Thirteenth Street and Rankin plants, Pittsburgh. He was advanced to superintendent in 1906.

Mr. Graves remained with the Allegheny Light Co. until it was taken over by the Duquesne Light Co. in 1913. On July 1, 1920, he was appointed assistant general manager of the Duquesne Light Co., and was made manager two years later. He was promoted to vice-president and general manager of the company Jan. 1, 1925.

During the World War he was a member of the Federal Power Board of the district, and immediately after became active in various power projects of the country.

Virginia Suffers Low Power From Water Shortage

Low water in the Rappahannock River, resulting from an extended dry period, has caused a shortage of electric power at Fredericksburg, Va., and several large consumers have been forced to curtail their operations greatly.

No water has come over the dam above the city for several days, the level at present being several feet below the top, and the power company does not have sufficient flow to run its hydro plant at full capacity. A large auxiliary plant, operated by a Diesel oil engine, has been put into service, but even with this the total output is not enough to supply all customers. Service to the Whiting-Turner Construction Co., which is doing extensive railroad work here, the Massaponax Sand & Gravel Co. and other large concerns has been cut off.

New York Power Group To Include Troy Co.

A seventh company will soon be added to the superpower corporation controlling six large gas and electric companies in the Hudson and Mohawk valleys, it was indicated July 26, when the board of directors of the Troy Gas Co., N. Y., advised the stockholders of that concern to exchange their stock for that of the Mohawk-Hudson Power Corp.

The Mohawk-Hudson already owns all the stock of the Municipal Gas Co. of Albany; the Adirondack Power & Light Corp., operating in Schenectady and all through the Adirondacks; the Cohoes Power & Light Corp.; the Eastern New York Utilities, Inc., operating in Rensselaer; the Fulton County Gas & Electric Co. and the Utica Gas & Electric Co. While most of these companies sell gas, the major interests of all of them are the sale of electric power and the operation of power projects.

The interests of the superpower holding corporation probably will be extended eventually to include all major power projects in the central part of the state. An application for acquisition of the Syracuse Lighting Co., the Seneca River Power Co. and the Mexico Electric Co. already has been reported as filed with the public service commission and one hearing on it took place recently.

"Application to the public service commission for approval of the transfer of the stock of the Troy company to the Mohawk-Hudson holding corporation will be made at once," Charles S. Ruffner, president of the Mohawk-Hudson, stated.

Recent Projects Licensed by Power Commission

The application of the Broad River Power Co. for a preliminary permit covering a power project on the Saluda River at Drehers Shoals, S. C., has been rejected by the Federal Power Commission. This application was in conflict with that of the Lexington Waterpower Co. which is regarded as the more comprehensive development of the resources of the river.

The commission has recently issued and forwarded licenses to the Pacific Power & Light Co. for a transmission line in Washington; California-Oregon Power Co., transmission line Chiloquin to Bray Mill; Bluster Gold and Silver Mining Co., transmission line in Nevada, and to the town of Highlands, N. C., for a small municipal development on the Cullasagee River.

Preliminary permits have been forwarded as follows: To Roy Holland, Fox River, Illinois; Knight, Kay, Stone, Haw, Breeden and Wilson, 6,000 hp. project on New River in California, and to the Illinois Northern Utilities Co., for a development on the Illinois River near Byron.

Salvage Story of S-51 Told Engineers at Banquet

Interesting aspects of the recovery and human side of the raising of the sunken Submarine S-51 were recounted by Commander Edward Ellsberg at a complimentary dinner given to him by C. R. Hulsart, vice-president of the Atlas Lumnite Co., at the Engineers Club, New York City, Aug. 3.

Under the present plan of the Navy to restore the S-51 it will be necessary to have all parts of the electrical equipment replaced, stated Commander Ellsberg, due to water damage beyond remedy. The 1,100-hp. Busch-Sulzer Diesel engine, however, is in almost perfect working condition to be operated at any time, he said.

The guests included: Robert Ridgway, chief engineer, Board of Transportation; F. J. Litter, chief engineer, Frederick Snare Corp.; Ole Singstad, chief engineer, the Holland Vehicular Construction Co.; Charles H. Boynton, assistant to the president, The Atlas Portland Cement Co.; F. E. Schilling, general superintendent, the Turner Construction Co.; George V. Salle, engineer of The Foundation Co.; W. V. McMenimen, vice-president, The Raymond Concrete Pile Co.; A. H. Ammann, chief engineer, New York Port Authority; C. R. Hulsart, vice-president, the Atlas Lumnite Cement Co.; George Chamberlain, chief engineer, Booth & Flinn, builders of the Holland Vehicular Tunnels; R. L. Davis, engineer for The Foundation Co.; Col. John P. Hogan, consulting engineer; L. H. Morrison, *Power*, and F. E. Schmidt, *Engineering News-Record*.

Report on St. Lawrence Dam Sites Ready Soon

Report of the joint engineering board now making a study of dam sites and other features of the St. Lawrence project probably will be ready by Oct. 1, it was stated by Maj. Gen. Edgar Jadwin, chief of engineers, on his return from the meeting of the board at Valley Field, Canada. The entire session of the board was devoted to work on the report. Decided progress has been made since the last meeting.

Co-operation, Floods—Power Men's Spring Harvest

The experiences last spring of the New England Power Co. and two interconnected systems, the Adirondack Power & Light Corp. and the Power Corporation of New York, are cited by utility men to illustrate the advantages of uniting systems operating on different watersheds and of providing interchange of current with steam plants.

Through unified operation the companies were able to utilize the energy of water supplied by freshets occurring at different times, in such a way that the benefits of the flood-water period were made to last three weeks longer than otherwise would have been possible.

The solution of this conservation problem lies in interconnection with other power systems which can absorb surplus power to advantage, either among their own customers or by passing it on to others. In the case in question, at one time the Power Corporation of New York was pouring excess current into the transmission lines of the Adirondack system, which in turn was passing much of it on to the New England Power system, from whose lines it entered the steam generated systems at Boston, Worcester, Providence, Fall River and elsewhere. Steam turbines were shut down because surplus power was arriving, generated by the flood waters of the northern Adirondacks.

The co-ordination of power stations located on different watersheds was strikingly illustrated. The flood period of any one of the various rivers covered a span of about six weeks. But in combination full advantage was taken of high water for nine weeks.

South Carolina Plant Sold to General Gas & Electric

Broad River Power Co. has purchased the Enoree Power Co., of South Carolina, it was announced recently by the General Gas & Electric Corp., controlling the Broad River Co. The Enoree Power Co., which has a generating plant of 1,500 hp. capacity at Van Patton Shoals, S. C., supplies electricity to the towns of Fountain Inn, Simpsonville, Owens and Grey Court.

The Enoree plant, containing two waterwheel generators and a steam turbine, will be linked into the interconnected system of the General Gas & Electric Corp., the main source of electrical energy being supplied by the new steam station of the Broad River Power Co.

Power Gain for Ship Oil Engines Reported

An increase in the figures of the power of various oil engines being built or installed in vessels throughout the world is reported by the Transportation Division of the Department of Commerce. The indicated horsepower of these engines at the close of the quarter ending June 30, was 782,216, compared with 733,496 at the end of the quarter ending March 31, 1926.

A gain is also reported in the world figure for the shaft horsepower of steam turbines under construction or installation, which advanced to 399,740 at the end of the second quarter of the current year, compared with 362,415 at the end of the first quarter. The total of indicated horsepower of steam reciprocating engines declined from 432,968 at the end of the first quarter of 370,594 at the conclusion to the second quarter.

For Great Britain and Ireland, the total horsepower of marine engines under way at the end of June, was divided as follows: Steam reciprocating engines, 211,414; steam turbines, 145,915; oil engines, 278,209. For all other countries combined the division was: Steam reciprocating engines, 159,180; steam turbines, 253,825, and oil engines, 504,007.

Waterwheel Power Doubles in 17 Years

Capacity of waterwheels in water power plants in the United States has more than doubled in the last 17 years.

The Department of the Interior, through the Geological Survey, has issued a report of the amount of water power developed, as of Jan. 1, 1926, showing that the capacity of water wheels in plants of 100 hp. or more was at that time 11,176,596 hp., an increase of 1,138,941 or about 11.5 per cent since March, 1925.

California, for years second in the amount of developed water power, is now the leading State, with 1,831,980 hp. in water-power plants, New York having dropped to second place with 1,750,900 hp.

Washington now ranks third, Alabama fourth, North Carolina fifth, South Carolina sixth, Maine seventh, Wisconsin eighth, Georgia ninth, and Montana tenth. Massachusetts, which ranked fifth in 1908, has dropped out of the 10 leading states, although it is only a little way behind Montana.

Taylor Stokers Chosen for Italian Central Stations

American stokers will fire the new central station of the Societa Generale Italiana Edison di Electricita at Genoa, Italy, a contract for six Taylor stokers having been placed with the American Engineering Co., of Philadelphia.

The Genoa station is to be followed by two others at Milan and Reggio. Each will be of 100,000 kw. capacity, ranking as the largest in Italy and among the largest in Europe. They will serve the principal industrial region of Italy and will be tied in with numerous hydro-electric developments in the Italian Alps.

Decision to use Taylor stokers followed exhaustive studies by a commission of Italian engineers who visited the principal central stations of the United States and Europe. It was desired to be able to burn American coal, or British coal or lignite.

The stokers for the Genoa station will be of the same general design as those at the Kearny station of the Public Service Production Co. of New Jersey. They have been designed to permit of preheating the combustion air to 225 deg. F., which will make it practicable to burn fuel with high moisture and will improve the furnace conditions with any coal.

The Genoa station is to be completed by November, 1927, and the other two stations shortly afterward.

New York Power Concerns Consolidate

A certificate has been filed in the office of the Secretary of State of New York, through Jay T. Taaffe, attorney, Albany, merging the New Berlin Light & Power Co.; Madison Power Co.; Southern New York Power Co.; West Branch Light & Power Co. at Stamford; Waterville Gas & Electric Co. at Waterville; Sullivan County Light & Power Corp., Fleischmanns Light, Heat & Power Corp. at Fleischmanns, and the Delaware County Electric Light & Power Co., with the Moravia Electric Light, Heat & Power Co. at Moravia.

Lake Chelan Power Project in Full Swing

The Washington Power Co. is gradually crowding toward maximum speed the work on the hydro-electric project at Lake Chelan, Washington. In the excavation work for the power station five hundred men are working at six tunnel borings. Construction work for the dam in the Chelan River at the town of Chelan will start in September at low-water period and will be completed by March of next year. The initial development is for two generating units of 34,000 hp. each, with an ultimate capacity of 125,000 to 130,000 hp., at a total cost of $10[illegible]000,000.

Sicily To Electrify Her Sulphur Mines

An agreement has been concluded between the Sicilian sulphur producers and the Societa Generale Mettrica della Sicilia whereby the sulphur mines of the island will be electrified, according to a report to the Department of Commerce from Commercial Attaché H. C. MacLean at Rome, Italy.

A large steam power plant will be erected at Catania and three-phase current transmitted at 40,000 volts to transformer stations at Castrogiovanni, Saltanissetta, Sommatino and Campofranco.

Florida Plant Nearing Completion

Work on the $3,000,000 hydro-electric plant at Beson Springs, Fla., is progressing rapidly with hundreds of men on the job, according to officials of the company.

It is estimated that the plant will be in partial working order within a few weeks. When it is completed, it will be one of the main sources of electrical power for a large portion of central Florida.

Alaskan Plant Wiped Out by Fire

A power plant, a roundhouse and a locomotive, all owned by the Alaska Railroad, were destroyed by fire at Curry, a division point, 190 miles north of Seward, Alaska, July 18.

A $100,000 hotel owned by the railroad was put in darkness by destruction of the power plant.

Assistant General Manager Horn of the railroad left Anchorage, headquarters of the road, for Curry to investigate the blaze.

Portland's New Substation Being Rushed

The Portland Electric Power Co., Portland, Ore., has just completed plans and specifications for the new electric light and power substation to be erected at Beaverton to take the place of the one wiped out by fire on May 26.

The new structure will represent an outlay of $25,000, and will, when completed, represent the last word in substation construction. The electrical and mechanical layouts will comprise much that is so far developed in the electrical industry. It is expected that the station will be complete in September.

Industrials Buy New Diesel Locomotives

Within the next month or six weeks the oil-electric locomotive, which has been attracting much attention lately in the railroad field, will make its initial appearance in mining and lumbering operations.

A locomotive of the 60-ton type, capable of developing 300 horsepower, and similar in design to oil-electrics that are now in operation at six important railroad terminals in the East and Middle West, is being built by the Ingersoll-Rand, American Locomotive and General Electric companies, for the use of the Utah Copper Co. at its mines at Bingham, Utah. A locomotive of the 100-ton type, 600 horsepower capacity, will be delivered at about the same time to the Red River Lumber Co. for use in lumbering operations at Westwood, California.

African Plant To Operate on Lowest Fuel Cost

Two units of the Witback Power plant, South Africa, have been completed. The station ultimately will consist of five units, with a total capacity of 100,000 kw. It is believed that the operating costs will be the lowest in the world, as coal will be obtained at less than 2 shillings (50 cents) per ton.

Poland Plans Power Plants in Carpathians

The American-European Utilities Corp. is negotiating with the Polish government for a power concession in Galicia, it was learned lately. Under the proposed plan a triangular area in the industrial district east of Warsaw would be supplied from hydroelectric plants in the Carpathian Mountains.

Lightning Paralyzes Service of Tennessee Plant

Lightning struck three transformers at Lebanon, Tenn., July 26, belonging to the Tennessee Power Co., putting them out of commission and rendering power users there without power for several days. The cost of the transformers, of the large type is estimated at $1,800 each. Manufacturing plants of the city, had to suspend operations until new transformers could be installed.

Technical Sessions Feature Machine Tool Exhibit

The sixth annual Machine Tool Exhibition will be held in the Mason Laboratory of Yale University on Sept. 7, 8, 9 and 10. From a small affair with but ten exhibitors and about one hundred and fifty visitors six years ago, the New Haven Machine Tool Exhibition has grown to be one of the notable engineering meetings of New England and the biggest show of its kind in the country. Last year over 15,000 attended, including many from foreign countries, and over 120 of the leading machine tool manufacturers of the United States and Europe exhibited. By actual check the equipment was found to be valued at over one-half million dollars. This year as the exhibition will be larger, and the technical sessions still broader in scope, it will be more widely attended than ever. As has been the custom in previous years, the committee in charge is representative of the New Haven Section of the American Society of Mechanical Engineers, the Machine Shop Practice Division of the society, the Mechanical Engineering faculty of Yale University, and the New Haven Chamber of Commerce.

Practically all of the machines exhibited will be actually producing commercial material during the four days of the exhibition and this is one of the main reasons for the strong appeal to everyone.

Another Substation for Florida

The Florida Power & Light Co. has started work in Hollywood on an additional substation to cost when completed about $50,000, according to F. N. Fairbanks, superintendent of the plant.

The new substation will be in addition to the substation erected there five months ago when the corporation bought out the local power company, known as the Hollywood Power & Light Co.

The new substation, which will be hooked up and in operation within the next thirty days, will give the city seven times its present power facilities.

Mechanical Stokers Show Increase in June

Mechanical stokers sold by the United States in June, as reported to the Department of Commerce by 12 establishments, numbered 175, with an aggregate horsepower of 68,408. This compared with 128 of 44,095 hp. in June, 1925. Installed under fire-tube boilers were 24 of 2,740 hp., compared with 26 of 4,625 hp. during June, 1925. The 151 others were installed under water-tube boilers, aggregating 65,668 hp. compared with 102 in June of last year, which aggregated 39,570 hp.

G. E. Building Largest Synchronous Condensers

Synchronous condensers of far greater capacity than any ever previously built are being obtained by the Southern California Edison Co. for regulating the voltage along the transmission lines which carry power from remote hydroelectric developments into Los Angeles. Each of the three condensers, which are being built by the General Electric Co., is rated at 50,000 kva., 13,200 volts, 50 cycles, 600 revolutions per minute. Two are to be installed in the new Lighthipe substation and the other in the Eagle Rock substation.

Obituary

Thomas F. Keefe, division manager of the Wisconsin Power & Light Co. properties in southern Wisconsin, died recently at the age of 50 years. Mr. Keefe has been identified with the public utility business throughout his long career. On completion of his university education he affiliated himself with the Wisconsin Telephone Co. for several years. He left that organizatoin to become local manager of the Wisconsin Power & Light Co.'s property at Baraboo and Mineral Point, Wis., and Ironwood, Mich.

Personal Mention

W. A. Sloan has been appointed an assistant professor of Mechanical Engineering, University of Pennsylvania.

D. Vaughn Waters has left Elizabeth, N. J., and is now located at the Hawthorne Works of the Western Electric Co., Chicago.

L. W. Barger is now works engineer for both the Symington Co. of Rochester, N. Y., and the Gould Coupler Co. of Depew, N. Y.

Thomas W. Wootton, formerly connected with the Adirondack Power & Light Corp., Schenectady, N. Y., is now affiiated with the engineering department of the Duquesne Light Co., Pittsburgh, Pa.

F. E. Weymouth has suspended his work as active head of Brock & Weymouth, Inc., although he remains a director and consultant of the company, and has been engaged by J. G. White Engineering Corp. as chief engineer for work in Mexico.

Dr. A. Frigon, director of studies at the Ecole Polytechnique, Montreal, has been appointed chairman of the Electrical Commission of that city in succession to the late Louis Herdt. Dr. Frigon was at one time connected with the Montreal Light, Heat & Power Consolidated and later practiced in Montreal as consulting engineer.

Joseph H. Lewis has resigned from the engineering staff of Dwight P. Robinson & Co., to become chief engineer of the Blue Ridge Glass Corp. at Kingsport, Tenn.

Major Glenn E. Edgerton, chief engineer of the Federal Power Commission, has returned from a trip to Europe, where he visited the Exhibition for International Navigation and Utilization of Hydraulic Power at Basel, Switzerland.

Business Notes

The Sullivan Machinery Co. announces that its Boston office, formerly at 201 Devonshire Street, has been removed to Suite 701, 45 Milk Street.

The Andrews-Bradshaw Co., Pittsburgh, Pa., sales manager for the Tracy Steam purifier, has appointed L. F. Kuhman vice-president and director of the company.

The Graybar Electric Co. announces the appointment of A. B. Vandercook, as assistant manager, and H. T. Simmons, as sales manager of the Los Angeles, Calif., distributing house of the company.

The Kuhlman Electric Co., of Bay City, Mich., manufacturer of power distribution and street-lighting transformers, announces the establishment of a factory office at 3-260 General Motors Building, Detroit. Richard P. Johnson will have charge of this office.

The Techno-Service Corp., 46 West 40th St., New York City, manufacturers of the Borsig valve, has appointed Charles Clees, Jr., sales manager for the districts of New York, New Jersey and Pennsylvania. Mr. Clees was formerly connected with the Golden-Anderson Valve Specialty Co. and the Everlasting Valve Co.

The Louis Allis Co., Milwaukee, Wis., manufacturer of Louis Allis and Watson direct and alternating current motors, has recently added to its staff the following representatives throughout the United States: The C. R. Reynolds Co., 1308 Jackson St., Toledo, Ohio; Southern Engineering Co., 301 Lyric Bldg., Birmingham, Ala.; Electron Engineering Co., Whitney Central Bldg., New Orleans, La., and D. H. Hull, 432 N. Montgomery St., Memphis, Tenn.

The Treiber Diesel Engine Corp. has been formed recently by O. D. Treiber, associated with Carl G. Fisher and H. B. Joy, to build high-grade Diesel engines catering to marine and yachting service particularly and also to the locomotive and rail car service. The company will utilize the facilities of the New York Shipbuilding Co. plant at Camden, N. Y., which is now owned and operated by the American Brown Boveri Electric Corp. Mr. Treiber will act as president, with offices in the Heckscher Building, 720 Fifth Avenue, New York City.

The American District Steam Co., North Tonawanda, N. Y., announces the taking over of the Nelson gate valve patterns for 125 and 250 lb. pressure, as well as 400 lb. pressure Nelson valves. The Nelson valve is, therefore, again available, and production facilities are reported as making prompt shipment possible.

Trade Catalogs

Heating and Power Plant Specialties—Kieley & Mueller Inc., New York City. This is a supplement to the general catalog of the company and describes and illustrates only the Kieley specialties most widely known. A copy of the general catalog will be sent on request from 34 West Thirteenth St., New York City.

Electric Traveling Cranes and Hoists—Milwaukee Electric Crane Manufacturing Corp. Dependability of the crane made by this company is stressed largely in respect to its positive lubrication. In the compilation of this catalog, No. 100, much useful information was included on the problems of electric traveling cranes and hoists in addition to many particulars on the Milwaukee equipment. The catalog is lavishly illustrated.

Air Lift Pumping Equipment—The Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. Bulletin No. 71-1, containing 48 pages, including many illustrations and figures of installations and parts of the Sullivan pumping equipment, features a particular description of the air made well. Layouts showing a different combination design for varying conditions also appear. Air-lift performance is given in the table and chart, and instructions for securing well data and for estimates on air-lift pumping are treated in detail.

Safety Lubricator—Keystone Lubricating Co., Philadelphia, Pa. A 48-page booklet, entitled "The Keystone Safety Lubricator; Questions Answered and Typical Installations Illustrated." As its title implies, it is a thorough discussion of the lubricator, its purpose, method of operation, relation to safety, adaptability, etc. Various types of installation are discussed and illustrated together with the accessories that have been designed to reduce the time of lubrication attention as close as possible to zero.

Coming Conventions

American Society of Mechanical Engineers. Calvin W. Rice, 29 West 39th St., New York City. Regional meeting at Richmond, Va., Sept. 27-30.

Association of Edison Illuminating Companies. Chateau Frontenac, Quebec, Sept. 27-Oct. 1. P. S. Millar, 80th St. and East End Ave., New York.

Empire State Gas and Electric Association. Lake Placid Club, N. Y., Sept. 30-Oct. 1. C. H. B. Chapin, Grand Central Terminal, New York.

National Association of Stationary Engineers. F. W. Raven, 417 South Dearborn St., Chicago, Ill. Convention at Atlantic City, begins Sept. 14. Erroneously announced as Sept. 6-11. Annual conventions and exhibitions of state associations are scheduled for the following dates: **New York State Association.** Wilmer T. Meinzer, 3626-215 Place, Bayside, Long Island, N. Y. Postponed from June 11 to 12, at Troy, N. Y., to Sept. 12-13 at Atlantic City, N. J. **Wisconsin State Association.** R. L. Scott, Eau Claire, Wis. Convention at Milwaukee, Aug. 3-6; **Minnesota State Association,** C. A. Nelson, 800 22nd Ave., N. E. Minneapolis, Minn. Convention at Rochester, Minn., Aug. 4-6; **New Jersey State Association,** S. G. Dalrymple, 111 Hutton St., Jersey City, Convention at Atlantic City, Sept. 12; **Pennsylvania State Association,** Frank J. McCarron, 3647 North 11th St., Philadelphia, Convention at Philadelphia, Sept. 12-13.

Universal Craftsmen Council of Engineers. 24th convention and exhibit Milwaukee Auditorium, Milwaukee, Aug. 3-7.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	July 26 1926
Pool 1	New York	$2.50@$2.75
Smokeless	Boston	1.88
Clearfield	Boston	1.65@ 1.90
Somerset	Boston	1.75@ 2.00
Kanawha	Columbus	1.50@ 1.75
Hocking	Columbus	1.40@ 1.70
Pittsburgh	Pittsburgh	1.60@ 1.90
Pittsburgh gas slack	Pittsburgh	1.20@ 1.30
Franklin, Ill.	Chicago	2.25@ 2.50
Central, Ill.	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.10@ 2.25
West Ky.	Louisville	1.10@ 1.40
S. E. Ky.	Louisville	1.40@ 1.75
Big Seam	Birmingham	1.75@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1	New York	1.60@ 3.50
Buckwheat No. 1	Philadelphia	1.85@ 2.75
Birdseye	New York	.75@ 2.00

FUEL OIL

New York—July 29, light oil, tank-car lots; 28@34 deg. Baumé, 6c. per gal.; 36@40 deg., 6½c. per gal. f.o.b. Bayonne, N. J.

St. Louis—July 21, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.00 per bbl.; 26@28 deg., $2.05 per bbl.; 28@30 deg., $2.10 per bbl.; 30@32 deg., $2.15 per bbl.; 32@36 deg., gas oil, 5.8c. per gal.; 38@40 deg., 6.5 per gal.

Pittsburgh—July 19, f.o.b. local refinery; 30@34 deg., fuel oil, 5¾c. per gal.; 36@40 deg., fuel oil 6½c. per gal.

Dallas—July 24, f.o.b. local refinery 26@30 deg., $1.75 per bbl.

Philadelphia—July 22, 27@30 deg., $2.62½@$2.68½ per bbl.; 18@22 deg., $1.93@$1.99; 13@19 deg., $1.70@$1.76 per bbl.

Cincinnati—July 26, tank-car lots f.o.b. local refinery, 24@26 deg., Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—July 26, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.20 per bbl.; 26@30 deg., $1.30; 30@32 deg., $1.40.

Boston—July 26, tank-car lots, f.o.b. 12@14 deg. Baumé 4¾c. per gal.; 28@32 deg., 6c. per gal.

New Plant Construction

Ark., Hot Springs—Terry Dairy Co., 341 Whittington Ave., is in the market for 10 ton ice making machinery.

Calif., Los Angeles—F. Harpstrite, 419 Broadway, is having plans prepared for the construction of a 13 story office and stores building on South Olive St. Estimated cost $500,000. L. L. Smith, City Club Bldg., is architect.

Calif., Los Angeles—G. & A. Marcell, c/o L. A. Smith, Film Exchange Bldg., Archt., awarded contract for the construction of a 5 story hotel and apartment building on Hollywood Blvd. to Bard Co., Pacific National Bank Bldg. Estimated cost $500,000.

Calif., San Francisco—Hammill & Hall, Inc., 6242 Geary St., awarded contract for the construction of a 10 story apartment at Jackson and Steiner Sts., to Clinton Construction Co., 923 Folsom St. Estimated cost $500,000.

Conn., New Haven—Southern New England Telephone Co., 126 Court St., awarded contract for the construction of a 12 story office building on Court St., to Dwight Bldg. Co., 67 Church St. Estimated cost $500,000.

Ill., Chicago—Syndicate, c/o R. DeGoyler & Co., 307 North Michigan Ave., Archt., is having plans prepared for the construction of 17 story apartment building, at State and Goethe Sts. Estimated cost $2,500,000.

Ill., Chicago—O. J. Friedman, 10 South La Salle St., plans the construction of a 23 story office building at N. Michigan Ave. and Wacker Dr. Architect not selected.

Ill., Chicago—Syndicate, c/o H. K. Holsman, 307 North Michigan Ave., Archt., is having plans prepared for the construction of an apartment at East 67th St. and Crandon Ave. Estimated cost $800,000.

Ill., East Moline—Deere & Co., Moline, awarded contract for the construction of 1 story power house, at plant here, to J. H. Hunzinger, Security Bldg., Davenport, Ia. Estimated cost $150,000.

Ill., Peoria—City defeated $500,000 bonds issue, on July 20, for the construction of palm house, with steam heating plant, etc., for park system.

Ill., Rockford—Orpheum Theatre Co., W. N Van Marte, Jr., c/o Schumann Piano Co., will soon award contract for the construction of a 3 story apartment and theatre building on North Main St. Estimated cost $850,000 to $1,000,000. F. J. Klein, 331 Main St., Peoria, is architect.

Ill., Warsaw—City will receive bids until August 17, for improving waterworks system, including 80,000 gal. tank on tower, pumps, wells, etc. Caldwell Engineering Co., 36 North Side Sq., Jacksonville, is engineer.

Ind., Indianapolis—Indian Refining Co. is having plans prepared for the construction of a boiler plant, etc., here. Estimated cost $150,000. Private plans.

Kan., Wichita—Douglas Rutann Bldg. Co. will soon award contract for the construction of a 10 story apartment. Estimated cost $500,000. Schmidt Boucher & Overend, Fourth National Bank Bldg., are architects.

Ky., Louisville—J. G. Brown, W.-G. Apartments, is having plans prepared for the construction of a 4 story office building at Fourth Ave. and Broadway. Estimated cost $750,000. P. J. Bradshaw, Int. Life Bldg., St. Louis, Mo., is architect.

La., Baton Rouge—Dixon & Himmermon Interests, plan the construction of a 12 story hotel at Church and Laurel Sts. Estimated cost $1,000,000. Jones, Roessle & Olschner, Maison Blanche Bldg., New Orleans, are architects.

Md., Baltimore—Medical Arts Bldg. Corp., c/o M. E. Wright, American National Bank Bldg., Archt., is having plans prepared for the construction of an 8 story office and stores building, including 3 electric elevators at Cathedral and Richmond Sts. Estimated cost $800,000.

Mass., Boston—McLaughlin & Burr, 88 Tremont St., Archts., will receive bids until Aug. 17, for the construction of 1 and 3 story, temple, with administration and community buildings, at Riverway and Longwood Aves., Berners and Plymouth Sts., for Congregation Adath Israel Temple, 692 Commonwealth Ave. Estimated cost $1,000,000.

Mass., Newton (Boston P. O.)—Newton Hospital, C. E. Kelsey, Pres., is having sketches made for the construction of a hospital on Beacon St. Estimated cost $1,500,000. Densmore, LeClear & Robbins, Park Sq. Bldg., Boston, are architects.

Miss., Natchez—Hotel Eola, awarded contract for the construction of a 7 story hotel on Pearl St. to J. V. & R. T. Burkes, Carondelet Bldg., New Orleans, La. Estimated cost $500,000.

Miss., Vaiden—Board Trustees of Vaiden Separate School District, is receiving bids for installing Delco automatic pump on proposed 200 to 400 ft. well. W. W. Miller is secretary.

Mo., St. Louis—City of St. Louis, c/o Bd. Public Service, will soon receive bids for refrigeration equipment, etc., for administration building of Isolation Hospital, on Arsenal St. Estimated cost $27,500.

Mo., St. Louis—Evangelical Deaconess Home & Hospital, F. P. Jens, Supt., 4215 West Belle Pl., will soon receive bids for the construction of a 4 story hospital at Oakland and Clayton Aves. Estimated cost $500,000. T. P. Barnett, Arcade Bldg., is architect.

Mo., St. Louis—Local Syndicate, c/o Pleitsch & Price, Arcade Bldg., awarded contract for the construction of a 15 story apartment on Lindell Blvd. to W. H. Smith-Nelson Cunliff Co., 110 North 7th St. Estimated cost $1,000,000.

Mo., Springfield — Employees Hospital Assn., St. Louis and San Francisco Ry. Co., St. Louis, plan the construction of hospital here. Estimated cost $600,000. R. C. Stephens, St. Louis & San Francisco Ry., St. Louis, is architect.

N. J., Newark—T. M. Griffith, 605 Broad St., awarded contract for the construction of a 12 story office building to Essex Construction Co., 9 Hackett St. Estimated cost $850,000.

N. J., Totowa (mail Paterson)—Bd. Institutions & Agencies, State Office Bldg., Trenton, soon awards contract for the construction of a power house, laundry, etc., at New Jersey Training School for Feeble Minded Females, here. Estimated cost $405,000. C. Leathem, Jr., State Office Bldg., Trenton, is architect.

N. Y., Brooklyn—Kings Highway Apartment, Inc., c/o E. M. Adelsohn, 350 Stone Ave., Archt., is having plans prepared for the construction of a 6 story apartment at Kings Highway and Clarkson Ave. Estimated cost $600,000.

N. Y., Flushing—The Flushing Hospital, is having sketches made for the construction of an addition to hospital on Franconia St. Estimated cost $500,000. York & Sawyer, 100 East 42nd St., New York City, are architects.

N. Y., New Rochelle—B. F. Keith Corporation, Palace Theatre, Bway. and 47th St., is having plans prepared for the construction of theatre and office building at Main and Center Sts., here. Estimated cost $1,000,000. H. J. Krapp, 1 West 47th St., New York City, is architect.

N. Y., New York—E. Ellinger, c/o Schwartz & Gross, 347 5th Ave., Archts., will soon receive bids for the construction of a 15 story office and stores building on East 52nd St. Estimated cost $500,000.

N. Y., New York—Gordon & Verber, c/o Glick & Dumas, 375 East Fordham Rd., Archts., are having plans prepared for the construction of a 6 story apartment on Townsend Ave. Estimated cost $500,000.

N. Y., New York—Landale Construction Co., c/o Turner & Bowden, 15 East 40th St., Archts., will build a 6 story apartment on East 260th St. Estimated cost $700,000.

N. Y., New York—S. Solomon, 152 West 42nd St., is having sketches made for the construction of a 25 story office building at Cortland and West Sts. Schwartz & Gross, 347 5th Ave., are architects.

N. Y., Ossining—Standard Oil Co., of New York, 26 Broadway, New York, is having plans prepared for the construction of a 5 story office building on Depot Sq. here. Estimated cost $500,000. Private plans.

Neb., Lincoln—W. E. Sharp, 421 Terminal Bldg., is having preliminary plans prepared for the construction of a 15 story office building. Estimated cost $1,200,000. J. G. McArthur, Keeline Bldg., Omaha, is architect.

Pa., Philadelphia—Chanceller Realty Co. c/o R. B. Bencker, 13th and Chestnut Sts., Archt., will soon award contract for the construction of a 15 story office building at 1420 Walnut St. Estimated cost $1,200,000.

Pa., Philadelphia — Friends Hospital awarded contract for the construction of a 1 story boiler house, at Roosevelt Blvd. and Asylum Pike to Barclay White Co., 1713 Sansom St.

Pa., Philadelphia—United Gas Improvement Co., Broad and Arch Sts., awarded contract for the construction of 14 story office building at Broad and Arch Sts., to Murphy, Quigley & Co., 1524 Sansom St.

Ore., Portland—J. A. Charlesworth, Fifth and Salmon Sts., is having plans prepared for the construction of a 6 story theatre and office building at Broadway, Salmon, Park and Main Sts. Estimated cost $2,000,000. Rapp & Rapp, 1747 Howard St., Chicago, Ill., are architects.

Tenn., Knoxville — Dooley-Gillespie Realty Co., Deaderick Bldg., awarded contract for the construction of a 17 story hotel on Gay St. to Worsham Bros. Construction Co., Empire Bldg. Estimated cost $1,000,000.

Tenn., Memphis—I. A. Baum, Columbian Tower Bldg., is preparing tentative plans for the construction of a 12 story office building at North Second and North Court Sts. Estimated cost $800,000.

Tex., Asherton — Texas Central Power Co., Frost Bldg., San Antonio, plans waterworks system, including pumping equipment, etc.; also electric light system. Estimated cost $25,000 and $15,000 respectively. Private plans.

Tex., Edinburg — Farmers Produce Co., Edinburg, plans the construction of a cold storage plant, here. Estimated cost $25,000.

Tex., Edinburg—M. Goodwin having preliminary plans prepared for irrigation project, with machinery, pumps, etc. Estimated cost $400,000.

Tex., Galveston—J. H. Langben & Associates, 410 Guaranty Bldg., plan the construciton of a 7 to 10 story hotel at Ave. F and 21st St. Estimated cost $500,000. Architect not selected.

Tex., San Antonio—F. C. Gross & Associates, c/o Gross National Bank plans the construction of a 12 story office building at Navarro and Commerce Sts. Estimated cost $500,000. H. T. Phelps, Hicks Bldg., is architect.

Wis., Milwaukee—Chain Investment Co., c/o Rosman & Wierdsma, 490 Broadway, Archts., awarded contract for the construction of an 8 story apartment and stores building on Grand Ave. to Reisinger & Co., 464 Oakland Ave. Estimated cost $600,000.

Que., Montreal—St. Catharine-Stanley Realty Corp., c/o Ross & McDonald, 1 Beemont St., Archts., awarded contract for the construction of an 11 story office building at Stanley and St. Catharine Sts. to Quinlan, Robertson & Janin, Ltd., 702 Sherbrooke St. W. Estimated cost $1,500,000.

Ont., Ottawa—Ottawa Electric Co., D. R. Street, Pres., 35 Sparks St., plans the construction of a 10 story office building. Estimated cost $600,000. Architect and engineer not selected.

Ont., Toronto — Central Sites Development Co., c/o N. A. Armstrong Co., Ltd., King St., Archt., is having plans prepared for the construction of 5 story and basement, stores and office building at Bloor and Bay Sts. Estimated cost $1,250,000.

B. C., Vancouver—Georgia Hotel, Ltd., 510 Hastings St., awarded contract for the construction of a 12 story hotel at Georgia and Howe Sts., to Dredging Contractors, Ltd., 510 Hastings St. Estimated cost $1,500,000.

New Zealand, Wellington — Secretary Dept. Public Works, Supplies and Tenders Committee, will receive bids until November 2nd, for switchgear for Waikanemoano Electric Power Development.